SCIENTIFIC AMERICAN

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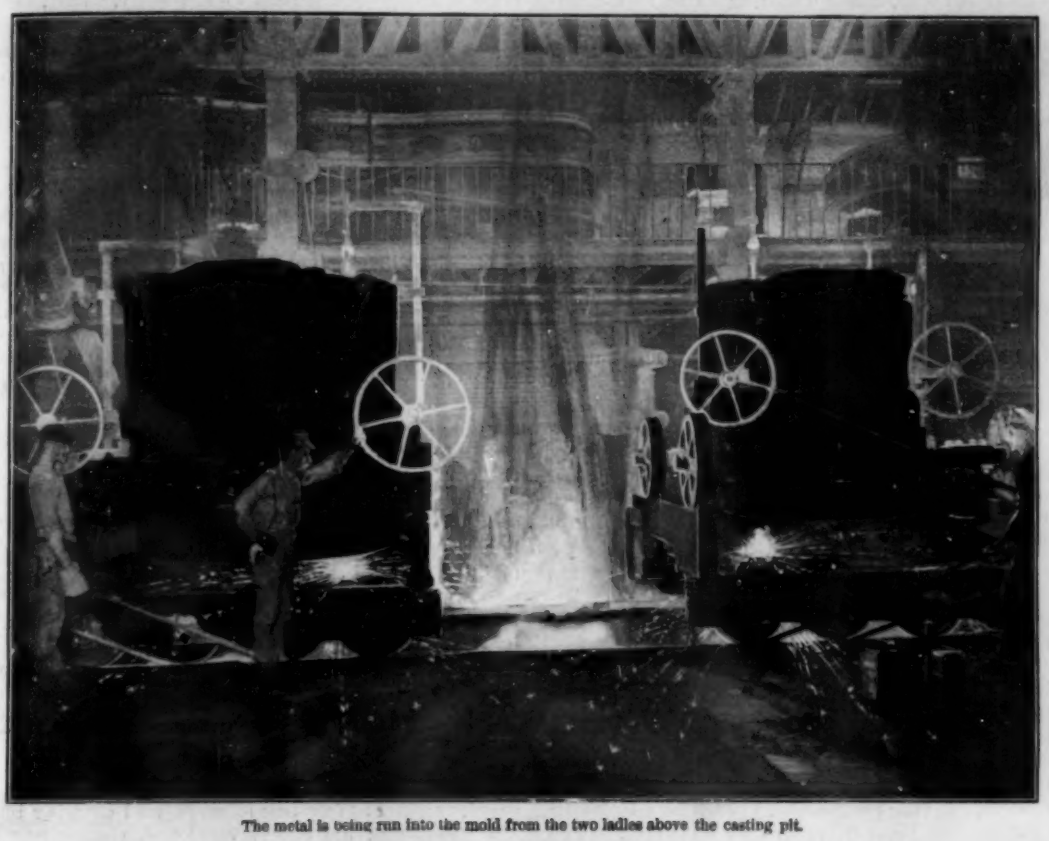
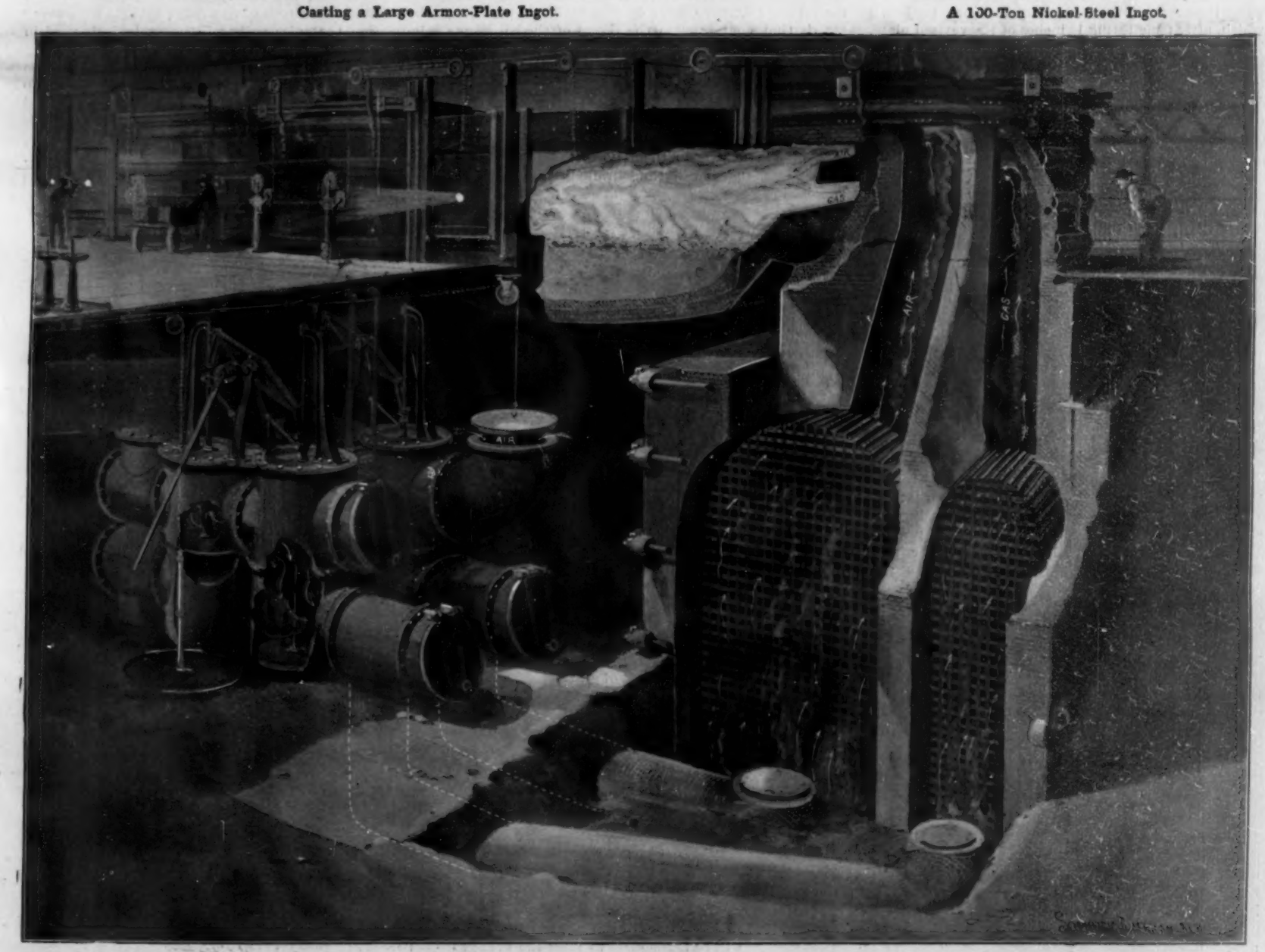


The metal is being run into the mold from the two ladles above the casting pit.

Casting a Large Armor-Plate Ingot.

Cast for tube of 16-inch, 135-ton army gun.

A 100-Ton Nickel-Steel Ingot.



Part Sectional View through an Open Hearth Furnace, Showing Regulating Valves, Checkerwork and Air and Gas Flues.

MANUFACTURE OF GUNS AND ARMOR AT THE BETHLEHEM STEEL WORKS—I. THE OPEN HEARTH PROCESS.—[See page 312.]

Scientific American.

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CAPPED PROJECTILES AND PANIC LEGISLATION.

Several years ago during some armor-plate trials in Russia, in which the plate had thoroughly beaten the projectile, it occurred to some one to cover the hard face of the armor with a thin plate of soft steel. The result was magical, a shell which splintered hopelessly on the hard face now boring its way through both plates with impunity. It was evident that the soft plate served to embrace and hold together the point of the projectile during the critical moment when it was breaking its way through the intensely hard surface of the armor. Once through the surface, penetration through the softer body of the plate was easy.

Projectiles, however, could not carry soft plates around with them, nor was it necessary. A small cap of soft steel, attached to and covering the point of the shell would serve equally well; and so the capped projectile took its place as one of the most effective inventions in the development of guns and armor. The invention was taken up and perfected by the Johnson firm of Spuyten Duyvil, New York, and their fluid-compressed, steel-capped projectile secured a world-wide reputation when a 12-inch shell penetrated 18 inches of Harveyized steel, although striking the plate obliquely at an angle of 21° from the normal, and with the customary velocity of 2,000 feet per second.

But all this is ancient history, and was duly recorded in the SCIENTIFIC AMERICAN, of December 5, 1896, when illustrations were given of a 6-inch projectile which, after penetrating 10 inches of Harveyized plate, had sufficient energy left to carry it 8 feet into the sand embankment at the rear—a total energy equal to the penetration of 12 to 14 inches of plate. The perforation of Harvey plate and of Krupp plate of lesser thickness, has subsequently been accomplished with capped projectiles, probably at every armor-proving ground in the world.

It seems that on a recent occasion our own navy officials, by giving it a high velocity, put a 6-inch capped shell cleanly through a 6-inch Krupp plate, and drove a shell of the same caliber through 14 inches of Harveyized steel. Both were remarkable performances, though if we bear in mind the experiments of 1896 above referred to are in no sense phenomenal. Nothing would have been heard of the matter outside of military circles had not the item found its way to the awestruck ear of a member of the Senate, who, communicating the secret to others, produced such consternation that the Senate forthwith closed its doors, and in secret session debated what emergency measures must be taken in view of the profound revolution in the relative efficiency of guns and armor which had just taken place, and had only now fortuitously come to the knowledge of Congress.

By some occult process of reasoning, this routine proving-ground test was taken to imply that the vaunted superiority of face-hardened armor being now shown to be a myth, there was herein clear proof of the fraud (long suspected) which the armor plate makers were perpetrating upon the government; for who would now think of paying $450, to say nothing of $545, per ton for plate that had just been shown to be little short of worthless?

The incident has an obvious moral; for surely it is not asking too much to suggest that the gentlemen upon whom devolves the grave responsibility of saying the last word as to what shall and what shall not be done in matters naval and military, should keep themselves so far informed on these technical questions as to be able to debate them with intelligence, dignity, and deliberation.

THE SHRINKAGE OF LAKE NICARAGUA.

In the current issue of the SUPPLEMENT will be found an article by Prof. Heilprin, entitled "The Shrinkage of Lake Nicaragua," which is certainly the most significant, we had almost said dramatic, contribution to the literature of the Nicaraguan region that has yet appeared.

In our issue of February 24, the same author, whose geographical and geological attainments give him eminent authority, showed that there is abundant evidence, drawn from the inconsistency of early recorded levels with those of later surveys, and from other phenomena, that there has been a gradual falling of the lake level. A reply to this article by Mr. C. Willard Hayes, geologist of the Walker Canal Commission, was published in the SUPPLEMENT of April 28, and in the present article, while replying to Mr. Hayes, Prof. Heliprin fortifies the position taken in his former article, by proving from the records of rainfall, evaporation and outflow of the lake, furnished in the report of the Walker Commission of 1897-99, that there has been a shrinkage in the waters of the lake during the past twenty years.

It is evident that, if any doubt exists as to the permanence of the lake, a similar doubt exists as to the permanence of the canal; for not only is Nicaragua, with the canalized San Juan River, to form the major portion of the canal, but it is upon the maintenance of the lake at or above a certain specified minimum level that the very existence of the whole system depends. Should the waters of the lake in time fall below a level which would afford less than 30 feet (the proposed depth of the canal) at the points where the canal enters and leaves the lake, there would be absolutely no remedy for the disaster.

Does such a danger exist? Is there any evidence that the average losses by evaporation and outflow are in excess of the average gains by rainfall in the Nicaragua watershed? The question can be answered by gathering all the recorded data on the subject, and by a simple process of addition and subtraction, determining whether the volume of the lake is increasing, stationary or undergoing a steady shrinkage. The necessary data are furnished by careful records taken at Rivas, on the Pacific side of the lake, during the years 1880 to 1898 inclusive, and it is from these data that Prof. Heilprin has arrived at the discouraging conclusion "that the lake—unless, indeed, the official reports are inaccurate—has been steadily and progressively undergoing shrinkage, and that it must continue to do so in the future."

The determinations of altitude of the lake made by Galisteo, in 1871, and by Baily, in 1838, show that it formerly stood at a much higher level than that established by recent surveys, a fact which is confirmed by the report of Collinson to the Royal Geographical Society, in 1867, who states that "even the least observant native, dwelling on the lake, will tell how its banks are rising year by year visibly before his eyes." The most comprehensive record of rainfall, evaporation, etc., is that contained in the report of the Nicaragua Canal Commission of 1897-99, which, although it makes no specific analysis of its own figures to determine the question of net gain or loss in the volume of the lake, does actually afford confirmation of the statements of the early engineers, as Prof. Heilprin shows in his article.

It is made plain from the report that the intake of Lake Nicaragua—rainfall and drainage from its drainage basin—is apparently for almost every year less than the output—the loss due to evaporation and outflow; while in exceptionally dry years the evaporation alone is greater than the entire intake.

From November 1, 1889, to June 1, 1891, the total rainfall would have raised the level of the lake 45·75 inches. The evaporation alone would have lowered it 95 inches, a loss, outside of what would have run off through the San Juan River, of over 4 feet. The aggregate loss during three dry spells, not taking count of outflow through the San Juan, was 10 feet 10 inches.

The compensations for such losses must be found in periods of extraordinarily heavy rainfall; but despite the fact that immediately after excessive rains the lake has been known to rise two feet in six weeks, the greatest net accession to the lake for any entire year, during a period of 20 years, was considerably less than 2 feet.

In the year 1898, when the rainfall was 108 inches, the net rise of the lake was only 18 inches, and a comparison of the records show that during 19 years of successive observations (1880 to 1898) there were not more than four periods, the years 1893, 1897, 1898 and possibly 1886, when the lake held its own, and during these years combined the actual gains were less than 5 feet. On the other hand, in the single year 1890, when the rainfall at Rivas was only 31·81 inches, the loss was as great as the gains for the entire 19 years!

In calculating the net result of all the causes of supply and loss affecting the lake level, the average recorded evaporation is taken as 55 inches, and the outflow through the San Juan as 42 inches, or one-half the amount in the extremely wet season of 1898. On this basis there is a total loss of 363 inches as against a total gain of 114 inches, or a net loss of 20 feet 9 inches. From this result the author of the paper concludes that for a long period of years Nicaragua has undergone a very marked and progressive shrinkage.

It is true that the outflow through the San Juan may be controlled and water may be stored in wet seasons against the deficiencies due to drought; but although the evil day may be thus postponed it is only a question of time, if the lake be steadily shrinking, when the surplus storage will be inadequate to meet the ever-growing deficiency.

We agree with the author of this paper that "it is hardly less than amazing that these reports should not have been analyzed before, and their bearing given full consideration;" and, we trust, that Congress will recognize, in the grave considerations thus presented, a further inducement to await the results of the searching investigation which is now being made by the President's commission.

ELECTRICITY IN THE FIELD OF TRANSPORTATION.—A FORECAST.

In no branch of science has the century now fast nearing its end witnessed more rapid advances or remarkable applications than in electricity, which, in a brief space of one hundred years, has developed from a scientific curiosity to one of the most potent forces that enter into our industrial life. It is still but ill-understood, and not even adequately definable. So vast have been the changes which it has already wrought in chemistry and manufactures, and so powerful may be the influence which it is destined to exert over the arts, that one involuntarily looks into the future for a glimpse of its possibilities in the twentieth century.

Present developments give no reason to expect that electricity will ever completely supersede steam as a motive power of great railway systems. In the transportation of heavy loads through long distances, the use of electricity is accompanied with many inconveniences and disadvantages. The steam-locomotive, on the other hand, ever remarkable for its great tractive power and high speed, has, in late years, been so considerably improved that it will undoubtedly hold its own in the economical, long-distance haulage of freight. Improvements in smoke-consuming devices, in constructions for lessening vibration, and in arrangements for increasing the heating surface and boiler capacity, follow one another so rapidly that the merits of concentrated power, cleanliness and compactness are almost as characteristic of the locomotive as they are of the electric motor. But, although electricity may never be exclusively used as the motive power of our large railroads, there are certain conditions under which it may be far more satisfactorily employed than steam. Scarcity of coal and a superabundance of water-power, for example, may favor the construction of electric rather than steam roads. In Switzerland and the Alpine regions of Italy, short trains of moderate speed, running at frequent intervals and carrying but few passengers, are chiefly employed, electric power being used for reasons of economy; while there is every indication that electricity will be exclusively used in the subway systems of the future.

For suburban travel and the street railways of large cities, we find that electricity is admirably adapted to meet the requirements of punctuality, security, and speed. Electric power is eminently suited to the needs of the small road; the cars are small, the trains short, the superstructure light, and the system cleanly. Whether the over or the underground trolley or the storage battery will be the prevailing system, it cannot be doubted that for city and suburban service electricity will remain the best form of motive power. So widely is it now employed on tramways, that it practically monopolizes the field; and further advancement must be looked for only in intensive improvement, in increased efficiency and safety.

That electricity will actually supplant steam on short, industrial roads, such as those that connect mines with foundries, and factories with shipping wharves, is as certain as that it will be generally employed in city and suburban traffic. The small electric locomotive of great tractive power, easily controlled, ever ready for service, has proven itself of untold value, and, to a certain extent, has already taken the place of the steam-locomotive. The field which is here opened to electricity is not so limited as one might be inclined to imagine. The centralization noticeable in all branches of commerce, the combination of small factories to form giant industries, is becoming more pronounced with each succeeding year. Industrial plants, which cover acres of ground and which swarm with workmen, require a quick means of transporting material from building to building, and for this purpose electricity is the most convenient and, under many conditions, the cheapest form of energy that could possibly be employed. In many of these establishments large generating plants have been already built to drive the many motors, cranes, machine-tools, and labor-saving appliances, and the utilization of the same current employed in driving these machines, to operate short railways would be both practicable and economical.

Transportation by water will be affected by electricity less markedly than transportation by rail. The electric appliances which are now largely used on European canals have contributed much to increase the efficiency of these and other waterways. Electrically-operated cranes, elevating apparatus, and gates are multiplying; and the mule that now reigns supreme over the towpath is gradually giving way to the small, powerful, electric locomotive, capable of towing several barges at a time. On ocean-going steamers, electricity will occupy a minor place. At present it is employed

in lighting and in operating the steering-gear and various auxiliary machines. On warships it will find a more extensive application. Although it will not supersede steam as a means of propulsion, it will be more widely used than at present in the manipulation of turrets, guns and ammunition hoists, and the operation of deck winches and boat cranes.

Electric communication on land, in spite of its phenomenal development, may still be vastly improved in economy. Our present system of rapid telegraphy is expensive; the sending of a message by wire is even yet far too costly for the ordinary affairs of mankind. If the twentieth century inventor will concern himself with increasing the efficiency and reducing the cost and expense of existing means of electric communication, he will confer more solid benefit than by solving the problem of electrical vision or elaborating a system of wireless telegraphy.

A NATIONAL NEED.

There has been submitted to Congress a bill which proposes to merge the Office of Standard Weights and Measures in a new bureau, to be known as the National Standardization Bureau, whose function shall consist in the custody of the national standards; the comparisons of standards used in scientific investigations, engineering, manufacturing, commerce and educational institutions with the standards adopted or recognized by the government; the construction, when necessary, of standards, their multiples and subdivisions; the testing and calibrations of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific and manufacturing interests and are not to be obtained with sufficient accuracy elsewhere. The bureau is to exercise its functions for the government, for any State or municipal government within the United States, or for any scientific society, educational institution, firm, corporation or individual engaged in manufacturing or other pursuits requiring the use of a standard measuring instrument.

The importance of this bill is evident from a brief review of the conditions which call for the establishment of a bureau of this kind. It has always been acknowledged that the selection and care of the original standards of length, mass, capacity and temperature, to which subjects attention, until recent years, has been almost exclusively confined, is one of the most important branches of scientific work that comes under the control of the government. The remarkable developments which have taken place of late years in pure and applied science have enlarged the field of such duties, until it now includes so many branches of physical and chemical research as to call for a complete laboratory, furnished with means for making the most refined measurements known to modern science, if the proposed Standardization Bureau is successfully to cope with its duties.

Germany, England, Austria and France have established bureaus and departments, more or less of the kind contemplated in this bill, and it only requires a study of the duties of these institutions, and the generous appropriations granted for their maintenance, to be satisfied of the importance, in foreign eyes, at least, of problems pertaining to standards and standard measuring apparatus. The necessity for a United States Bureau is proved by the extraordinary rapidity with which institutions of learning, laboratories and scientific societies are being established throughout the country, the rate of their growth never having been equaled in the history of any other nation. The work done in these institutions requires reliable standards for which, at present, they are obliged to go abroad. The introduction of accurate scientific methods into our various industries moreover, calls for a multitude of standards of far greater accuracy than was formerly required. Thus to secure the most economical results it is often necessary to have an accurate knowledge of the high temperature of a furnace, or the low temperature of a refrigerating process; while important commercial transactions are based upon the reading of electrical apparatus, inaccuracies in which would result in great injustice and financial loss. There is a call, moreover, for many standards and instruments of precision in the different scientific departments of the government. Further proof of the necessity for this bureau is found in the recent acquisition of territory by the United States, which will involve readjustment of the system of weights and measures in the countries affected.

Hitherto the manufacturing of scientific apparatus and instruments of precision has been confined almost exclusively to foreign countries, although it is satisfactory to note that this country promises before long not only to be able to supply its own needs, but to produce instruments fully equal to the best of foreign makers. It is absolutely essential, however, if American manufacturers are to secure the requisite degree of uniformity and accuracy, that they have access to a standardizing bureau such as is provided for the manufacturers in other countries. It is sincerely to be hoped that Congress will look favorably upon this bill and not only enlarge the function of the present office of Standard Weights and Measures, but provide it with an adequate laboratory, equipment, and working force.

THE METHODS EMPLOYED BY THE ASSAY COMMISSION.

BY MARCUS BENJAMIN, PH.D.

Each year the President of the United States appoints through the Director of the Mint, a Commission consisting usually of fifteen persons, with the Judge of the District Court for the Eastern District of Pennsylvania, Controller of the Currency, and the Assayer of the assay office in New York, ex-officio, which is required to meet in Philadelphia on the second Tuesday in February for the purpose of examining the fineness and weights of the coins reserved by the mints in Philadelphia, San Francisco, New Orleans, and Carson City. An appointment to serve on this Commission is an honor highly appreciated by the scientific men of the country, and on the list of those who have served since its creation in 1874 may be found the names of many of our best known chemists and physicists.

The present writer has had the good fortune to meet with the Commission on two occasions, and believing that the readers of the SCIENTIFIC AMERICAN would be interested in learning something of the methods by which the government certifies to the public that the high standard of its coinage is preserved, the following has been written:

The Commission meets at the time appointed in the long room of the mint in Philadelphia where the coin collection is kept, and after organizing under the chairmanship of the Judge of the Eastern District of Pennsylvania, three committees are named, as follows: One on counting, one on weighing, and one on assaying, and then the Commission adjourns until such time as it shall be convenient for the committees to make their reports. Almost immediately after adjournment of the Commission, the counting committee assembles, which consists of the members of both the assaying and weighing committees, and to them are given the sealed packages containing samples from the several mints.

Each mint is by law obliged to take assay pieces from each coinage in each month in the proportion of one for each one thousand pieces, or any fractional part of one thousand pieces, in the case of gold coins; and of one for each two thousand pieces, or any fractional part of two thousand pieces in the case of silver coins. These are sealed in an envelop and shipped quarterly by express to the mint in Philadelphia, where they are carefully preserved in a pyx, under the joint care of the superintendent and the assayer to await examination by the Commission.

The committee on counting proceeds at once to open these envelops and verify the count which is indicated on the outside of the envelop. This operation generally requires two days, and in the case of the Mint Commission that met in February this year, it was said that 41,271 pieces of money, both gold and silver, representing a value of $125,103, were submitted before the Commission.

While this money is being counted samples are selected for the use of the weighing committee, and also for the assaying committee. Those taken by the weighing committee are removed to the balance room where, under the direction of the chairman, they are carefully weighed on a large delicate balance, precaution being taken in the first instance to carefully test the weights by a set of standard weights, the accuracy of which has been previously testified to by a certificate from the Bureau of Weights and Measures of the United States Coast and Geodetic Survey.

The following deviations are allowed: In the double-eagle and the eagle, one half of a grain; in the half-eagle, the three-dollar piece, the quarter eagle, and the one-dollar piece, one-fourth of a grain. In the silver coins the deviations are as follows: In the dollar, the half, and the quarter dollar, and in the dime, one and one-half grains.

The work of the assay committee is more complex, and it requires several days for its completion. Samples having been taken of the different coinages, beginning with the gold, these are then removed to the assaying department, where a piece of each coin is selected. Pieces representing about a quarter of the coin are struck off with a cold chisel. These pieces are then rolled out and numbers stamped on them, after which they pass to a special weighing room, where one-half of a gramme of gold is weighed from each sample. Sets of fourteen are generally taken, and of these two are of pure standard gold. The weighings are wrapped in a lead sheet with a certain proportion of silver, and the little cornets, as they are called, are then taken to the assay furnaces, where they are cupeled; that is to say, placed in small bone ash cup which absorbs all of the lead and other impurities. The silver button is taken from the cupel when cold, and after all adhering dirt is removed, is rolled into a convenient shape and then twisted into a little coil which is put into a small metallic basket. These baskets contain a number of apartments, and when the proper number has been obtained, the entire basket with its contents is deposited in a bath of nitric acid. This dissolves out all of the silver, leaving the gold in its purity. The gold thus obtained is then weighed, and the result represents the actual amount of gold contained in the sample. By this means the commission, knowing the original weight of the sample, and having extracted all the impurities are able to tell exactly the proportion of gold contained in the coin, or as it is commonly called, the "fineness." The two samples of pure gold serve as a check on the process, and are also used as a means of correcting the slight differences due to the conditions of the furnace, i. e., too great heat, or not enough. By reference to the Report of the Proceedings of the Assay Commission for 1899, the first four specimens of eagles from Philadelphia showed a fineness of 899·6, 899·8, 899·7 and 899·8.

When the samples of the gold coinage have all been assayed the committee then takes up the silver, the assay of which is accomplished in the following manner: As was the case with the gold coinage, samples of each denomination are selected and pieces from each coin are cut with a chisel. These samples are then rolled out and numbered by means of a punch, after which they are sampled by means of a punch which strikes out a number of small pieces a little larger than the head of a pin. Eleven and one-half grammes are then weighed and put into stoppered eight-ounce bottles into which 10 cubic centimeters of nitric acid are dropped. The bottles are then heated so as to dissolve the silver, after which, when they are cooled, 100 cubic centimeters of standard salt solution is added for the purpose of precipitating the silver. The bottles, in sets of twelve, are placed on a shaker which is operated by power and thoroughly shaken for four minutes in order that all of the silver may be separated in the form of chloride from the solution. The small remaining fraction of silver is then precipitated with a decinormal solution of salt, by means of which the exact proportion of silver is determined. The expert who finishes the operation possesses a very accurate eye, and, by adding a drop more or less of the standard solution, is able to tell to within a tenth of the exact amount of solution required to entirely precipitate the silver. In this case, as with the gold, two specimens of standard pure silver are carried through the operation in order to check the result.

On the completion of the work of the weighing and assaying committee, the Commission is again convened, and the reports of the different committees submitted, after which every member of the Commission is required to sign the report. A pleasing feature of the experience is that at the close of the meeting the superintendent of the mint presents each member of the Commission with a handsome medal that has been prepared for the occasion, containing the head of the president on one side and an appropriate symbolical design on the other, in recognition of his services.

A SPEEDY BUSINESS TRANSACTION WITH CHINA.

It is a trite saying that we have annihiliated space by the submarine cable. The remarkable ease with which business can be transacted with the Antipodes was shown a short time ago in the case of a Chinese client of the SCIENTIFIC AMERICAN Patent Agency, residing in the interior of China. He had given instructions that he was to be cabled to when his patent was allowed. He was cabled on the third of May, the rate being $1.60 per word: on May 7, a firm of New York bankers paid the funds necessary for the filing of several foreign patents, the instructions having come from Hong Kong by cable. In the four days that had elapsed between the sending of the cablegram and the paying of the money, messages were transmitted over a distance almost as great as the circumference of the earth at the equator, and had the business been transacted by mail the shortest time by the postal routes would have been fifty days provided that close connections were made.

EXCAVATIONS have been instituted on the site of ancient Knossos near Candia and the remains found are important. Mr. Hogarth has discovered a Mycenæan building on the hillside opposite the famous "Palace" site at Kephala, it seems to consist, as far as it has been cleared, of three halls, in two of which stand square pillars, a feature not hitherto apparent in structures of this period, except in a rude form at Phylakopi, in Melos. The walls were faced with thin slabs of white gypsum, many of which remain in their place, and the floors are paved with similar slabs. In what was apparently the tank of the house were found about forty vases, mostly capable of restoration and all in pre-Mycenæan. In the building itself have been found several gems and beads, obsidian tools and miscellaneous objects, besides hundreds of fragments of Mycenæan vases, which are more varied and elaborate in in design than any yet discovered even at Mycenæ. The building contains no trace of anything Roman or Greek. Preliminary excavations at Kephala were begun on March 27.

GREAT SUBMARINE BLAST IN SAN FRANCISCO BAY.

After several weeks of preparation, Shag Rock, one of the more prominent of the obstructions to navigation in San Francisco Bay, was successfully removed on the 30th of last month. The rock, well known to every navigator of that harbor, was located about a mile northwest of Alcatraz Island, and directly in the course of all vessels navigating the waters of the upper bay. It has been the scene of numerous wrecks. At high tide the summit was almost submerged, only a small point being visible; but at 30 feet below low water its base spread out in oblong shape to a diameter of over 180 feet. The shoal thus formed and the strong tides and currents at this part of the bay made the rock a menace which every navigator was anxious to avoid. The government has been urged to remove this rock for years, but not until the past twelve months has a systematic and accurate survey been made. A contract was then made whereby Arch Rock, Shag Rock, and Shag Rock No. 2 were to be obliterated inside of two years at a cost of $232,000.

Shag Rock was the first to be attacked. A frame, 180 feet in diameter and revolving about a huge mast, was put in place (see SCIENTIFIC AMERICAN, March 24), and from this platform, driven by power from a floating barge, drills nine inches in diameter were set to work, and inside of a month thirty holes were bored vertically into the rock to a depth of 34 feet below low tide. These were filled with explosive gelatine and connections made with an electric battery preparatory for an opportune moment for the explosion. Altogether nearly two tons of explosives were tamped into the rock.

When the time arrived, the bay in the vicinity was cleared within a circle of a mile, and the wires attached to a battery on board a barge anchored 6,000 feet away.

The time arrived, and after a signal from the barge the electric button was touched and the powerful explosive was ignited. Then was afforded a magnificent spectacle. There was very little sound, and scarcely a tremor was felt; but there arose a mighty geyser from the bosom of the sea, which ascended to an altitude of 1,000 feet, with branches extending at various heights, and gradually drooping as the huge mass of rock and water poised in mid-air, before falling from the dizzy height to which it had been hurled. There seemed to be but one explosion, and all was over in a few seconds. The waters soon became calm again, and signs of disturbance quickly vanished. Only the splintered wreck of the platform and a few dead fish floating about gave indication of the mighty eruption. The result of the explosion, so far as ascertained, has been all that was anticipated. Soundings show a depth of 18 feet at the highest point. Tons of rock have been blown into deep water and all that remains has been shattered into small portions which can be easily removed by the dredgers.

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Observed Height of Column, 1,000 Feet.

BLOWING UP OF SHAG ROCK, SAN FRANCISCO BAY

M. EMILE LAURENT, professor of the Agricultural College of Gembloux, has recently made a series of experiments on the use of nicotine in horticulture. The administration now furnishes a solution of sulphate of nicotine of 10 per cent strength, and it suffices to add 10 cubic centimeters of the solution to a liter of water in order to have a very effective insecticide solution. M. Laurent has, however, remarked that the liquid used in the ordinary manner adheres very imperfectly to the different insects, and proposes to make it more adherent by adding strong soap and carbonate of soda in the proportion of $\frac{1}{1000}$. The solution thus prepared has given satisfactory results, and its effects is quite conclusive. M. Cornu, of Paris, has made known a process of which he uses the juice of tobacco for the same purpose. Iron bars are heated to redness and brought to the center of the greenhouse, where the solution is projected upon them; this is instantly transformed into vapor, forming a thick cloud, which rises to the top. It condenses and falls upon the different plants and the insects are quickly destroyed. When thus deposited upon the leaves, this product has no harmful action upon the pores.

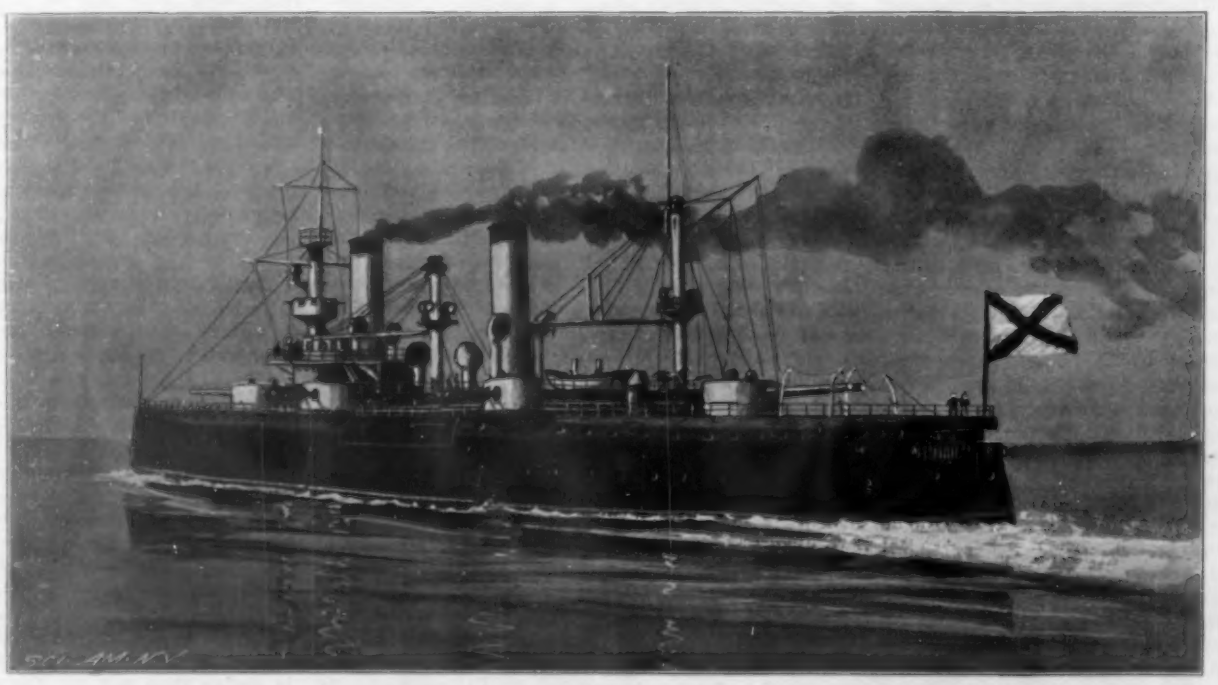
THE NEW RUSSIAN BATTLESHIP "PETROPAVLOVSK."

BY C. FIELD.

The Russian navy, already formidable, still continues to grow apace. One of its most recent armorclads is the "Petropavlovsk" at present performing the duties of flagship on the Pacific Station. This fine war vessel, which has a displacement of 11,500 tons, was constructed at the New Admiralty Yard at St. Petersburg, her engines being supplied by Messrs Hawthorne, Leslie and Company, of Newcastle-on-Tyne, and was launched in 1894, though not completed for sea till a comparatively recent date.

The "Petropavlovsk" is 367 feet in length and has a beam of 69 feet. She is provided with an armored belt over 15 inches in thickness, and a protective deck of 3·5-inch armor. Her two principal turrets are covered with 10-inch Harveyized steel plating; her four secondary ones and her casemates being of 8-inch armor. Her armament is a very formidable one consisting, as it does, of four 12-inch cannon mounted in pairs, fore and abaft her superstructure, and twelve 5·9-inch quick-firing guns eight of which are placed two together in her four secondary turrets, the remaining four being in casemates recessed on her main deck amidships. Besides these she carries no fewer than thirty-eight small rapid-fire and machine guns in addition to six torpedo tubes. Her machinery, of 10,600 horse power, consists of two sets of triple expansion engines supplied with steam by fourteen single ended boilers. On her trials the "Petropavlovsk" under natural draught realized a speed of about 17 knots an hour during a twelve-hour run. Her crew consists of 600 men and 22 officers, and she is now commissioned for the first time, and no doubt will be a most valuable addition to the important squadron that Russia maintains in the Far East.

The "Petropavlovsk," with her black hull and upperworks, against which her white turrets stand conspicuously out, her three masts (or rather two and a half) with their array of electric light projectors, her lofty funnels and recessed sternwalk, presents a somewhat unique appearance when contrasted with the warships of other nations. Doubtless, though, on the first hint of hostilities she would received a "fighting jacket" of dead black or lead-colored paint.



Displacement, 11,500 tons. **Speed,** 17 knots. **Normal Coal Supply,** 900 tons. **Armor:** Belt, 15-inch; deck, 3·5-inch; main turrets, 10-inch; Secondary turrets, 8-inch. **Armament:** Four 12-inch B. L. R., twelve 5·9-inch R. F., thirty-eight smaller R. F. and machine guns. **Torpedo Tubes,** 6. **Complement,** 622. **Date,** 1899.

NEW RUSSIAN BATTLESHIP "PETROPAVLOVSK."

Thomas Jefferson's Account of a Screw Propeller.

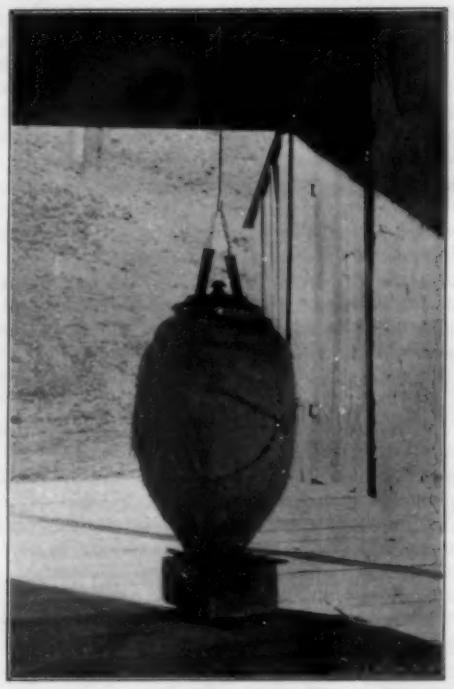
A correspondent from the University of Virginia sends us an extract from a letter of Thomas Jefferson, dated Paris, October 2, 1785, written to his scientific friend, Bishop James Madison, of William and Mary College, which illustrates Jefferson's well-known interest in scientific matters, besides being important as it contains a reference to the introduction of the screw-propeller: "I went some time ago to see a machine which offers something new. A man had applied to a light boat a very large screw, the thread of which was a thin plate, two feet broad, applied by its edge spirally around a small axis. It somewhat resembled a bottle brush, if you will suppose the hairs of the bottle brush joined together and forming a spiral plane. This, turned on its axis in the air, carried the vessel across the Seine. It is, in fact, a screw which takes hold of the air and draws itself along by it, losing, indeed, much of its efforts by the yielding nature of the body it lays hold of to pull itself on by. I think it may be applied in the water with much greater effect, and to very useful purposes. Perhaps it may be used also for the balloon."

MR. M. H. SAVILLE, of the American Museum of Natural History, has returned from a very successful trip to Mexico. The explorations at and near the noted ruins of Mitla have been so well prosecuted that little work is left to be done.

DEATH VALLEY, CALIFORNIA.

Death Valley is probably the most unique natural feature in California. It is located in the southeast corner of Inoyo County, and is inclosed by the Panamint Mountains on the west and the Funeral Range on the east. It is seventy-five miles long, and at its narrowest point but eight miles wide.

At one time, most probably, it was the bed of an ancient river. The lowest depression is 200 feet below sea-level, but above this rises Telescope Peak, 11,000 feet high, of the Panamint Range, and directly opposite the Funeral Peak, which reaches an altitude of 8,000 feet. During the winter these peaks are covered with snow.



WATER COOLER USED IN DEATH VALLEY.

This remarkable valley was discovered in 1850 by a party of immigrants, many of whom lost their lives in the attempt to cross it. The name has clung to it, also, as being the scene of numberless tragedies. Early in its history traditions of gold and silver deposits of wonderful richness within its boundaries persuaded many adventurous persons to undertake the hazardous experiment of its exploration. The number who have lost their lives in this desolate field is undoubtedly great. Pursuing the mirage of rich deposits of precious metals these adventurous prospectors succumbed at last to the intolerable heat and the agonies of thirst.

The range of the thermometer is probably greater in Death Valley than elsewhere in the Western Hemisphere. In winter the temperature is way below zero, while in July and August, the thermometer ranges for weeks at 137° above, frequently rising several degrees higher. For weeks at a time the lowest temperature observed exceeded 100°. The deadly heat burns every vestige of vegetation. The Spanish bayonet, a plant that flourishes under the most arid conditions, here barely survives, while the mesquite, with its long roots penetrating deep into the earth in search of scanty moisture, just manages to exist.

A party of enterprising agriculturists once experimented with growing fruit and vegetables in this region, anticipating large profits in the early marketing of their crops. The attempt was a complete failure, the intense heat withering the plants, notwithstanding copious supplies of water and the most skillful cultivation. In the higher altitudes of the Panamints there are numerous valleys with flowing streams. In these, fruits are cultivated, and reach the market two months before the California products mature.

The prevailing winds in Death Valley are from the west. Though originating in the Pacific Ocean and saturated with humidity in traveling the intermediate distance, they are intercepted by the lofty peaks of four ranges of mountains, which absorb all of their moisture, so that by the time they reach the valley all humidity has disappeared. The blasts are as if heated in a fiery furnace, and no living thing can survive the intense heat. Even birds, indigenous to the region, die.

It is in the months of greatest heat that the sand storms of Death Valley are most deadly. They rage with intense fury, obliterating the landscape and dimming the light of the sun, withering the scanty vegetation and covering the trails deep in powdered dust. At all times the aspect of the valley is superlatively desolate. No spot on earth surpasses it in aridity or tophet-like heat.

During the heated term an hour without water means death. Meat becomes putrid in an hour. Eggs are cooked in the blistering sand. Water is only palatable by means of large porous earthenware jars, common to all hot countries, suspended in drafts and reduced in temperature by means of the rapid evaporation of the moisture from the outside.

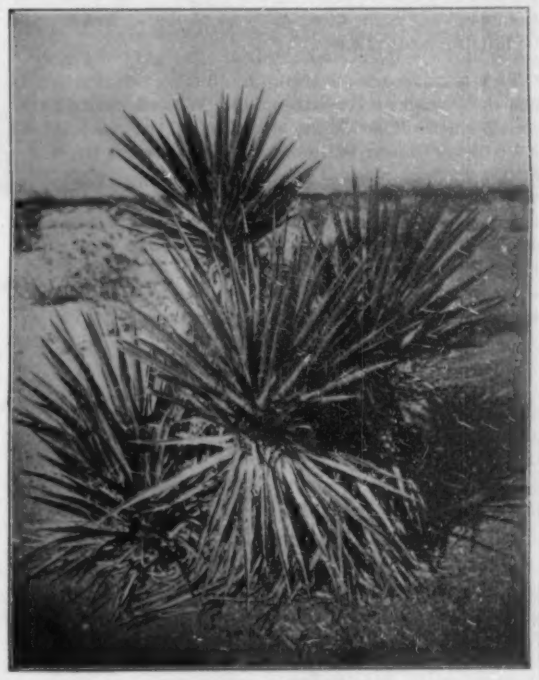
The belief that the borax marshes are the remains of the vast lake which once filled the valley is supported by traces of water-line found 600 feet above, on the mountain sides.

In general appearance all borax marshes are alike. They are located at the point of greatest depression and from a distance look like deposits of salt or snow. Under the surface is common wet clay or water of varying depths. These deposits are generally circular in form and appear as though once they were craters. Borax was created by contact of boracic acid in gaseous form, with the lime and soda of the surface. At Teels Marsh, Nevada, borate of lime appears in the form of balls imbedded in clay along with soda, salt, etc., but at Columbus these are found in sandy soil. Sometimes these balls are decomposed, underlying the soil which is removed, and the borate shoveled out. Deposits of crude borate of soda are found in Nevada and in Death Valley, at the Monte Blanco mines. The borax industry is so important that we shall have a special article upon the subject in the near future.

MOUNTAINS ENCLOSING DEATH VALLEY.

A New Substitute for Rubber.

An Italian residing in Mexico has recently devised a new composition intended as a substitute for caoutchouc in the manufacture of rubber goods. While residing in Mexico he observed a shrub growing in Central Mexico, and known to the Indians by a variety of names of which Yule is one. The shrub grows wild on the rolling land and attains the average height of three feet. An examination of the shrub led him to experiment with the same with reference to ascertaining what use might be made of it, since it grows abundantly, may be easily cultivated, roots readily from cuttings and may be cut two or three times a year and immediately begins to grow and shoots up again to form new wood. It does not belong to the plants which yield milky juices, being a comparatively hard wood and growing as a small scrubby bush, but there is found within its bark and wood a large amount of gummy matter and upon comminuting it by cutting finely, grinding, or pounding the same and macerating it with a hydrocarbon solvent such as gasoline, naphtha, ether of petroleum, oil of turpentine, or the like, this gum is softened and extracted from the wood and when extracted does not harden to crystallization, but still holding a small portion of the hydrocarbon remains as a viscid, sticky mass that fulfills all of the physical conditions of crude rubber. It may be vulcanized perfectly and is superior to most india rubber since it is free from all mechanical impurities and needs no preliminary cracking, grinding and washing, as does the ordinary crude rubber. The botanical name of this shrub is Synathereeas-Mexicanas, and it furnishes in gum the remarkable yield of 40 per cent of its own weight, while the method of extraction, and the admixture of a residual portion of the solvent gave as a new composition a brownish black viscid gum that it is not only free from all mechanical impurities, but may be brought by evaporation to any desired consistency, and is at once ready for use in the art without any preliminary washing and cleaning. It is abundant, cheap and may be treated either in a green state or in a dry state, so that it may be cut and baled and stored for any length of time and shipped without affecting its yield of gum.



SPANISH BAYONET PLANT IN DEATH VALLEY.

In preparing the composition for the market, these shrubs are pounded with wooden hammers and placed in a large iron mill in order to comminute the shrub, and this is carried on as a continuous process. The product is then placed in an iron reservoir for maceration where it is kept hermetically sealed for twelve hours with hydrocarbon solvents. The receiver has at the center several iron or wooden beaters to stir the mass during its process of maceration so that absorption may take place homogeneously. This comminuted shrub then assumes a mucilaginous condition and the receivers are put in a place heated to about 45° Centigrade. After standing until thoroughly soaked, it is taken out from the receiver, the mass being in the form of a mucilaginous pulp. It is then placed in bags of canvas, and these bags are closed in a hydraulic press. The gum that comes out falls into one or more tubes and are conducted to large receivers which contain reels to beat and stir the gum to dry out a part of the volatile solvent. In the place where these oils have volatilized there should be for the sake of economy a condensing apparatus to collect the vapors so as to use them again in dissolving other portions of the shrub. By this process the gum that comes out is chemically pure and suitable at once for manufacture, and it forms a new composition consisting of resin of the plant combined with a residual portion of the hydrocarbon solvent. This class of shrubs gives for a hundred pounds, forty pounds of gum, with a den-

sity at 15° C. of 0·980. This new composition has been termed "twentieth century gum," and among its advantages over ordinary rubber are first, saving in the cost of reproducing the plant; second, saving in the cost of exportation; third, saving in material used in purifying establishments; fourth, saving in fuel; fifth, in machinery; and sixth, saving in time.

Paris Exposition Notes.

It is estimated that 150,000 Americans will visit Paris sometime while the Exposition is open. These figures are said to be based upon the number of residents now abroad and the capacity of the transatlantic steamers. It seems very high, however, and probably 100,000 will be much nearer the mark.

The Experiment Station exhibit at the Paris Exposition is most interesting. Two various agricultural colleges and experiment stations in the association have contributed materials, charts, pieces of apparatus, models, etc. The collections of photographs and publications is a most imposing one and the photographs are displayed in portfolios; there being 750 in all. Some of the apparatus is very interesting, such as electrical devices for determining the salt content, temperature, and moisture content in soils. The California Station furnished an olive exhibit including fifty samples of olive oil. The Alabama Station, on the other hand, presented a collection of mounted specimens of cotton. Several pieces of original apparatus for investigation in vegetable physiology are shown. The dairy exhibit is the largest. In 1889 our agricultural experiment stations also made an exhibit at Paris, but the exhibit was small and unimportant compared with the present one.

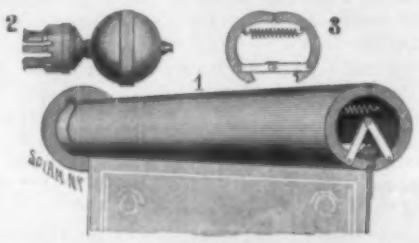
One of the interesting features of the Paris Exposition is the elevated moving sidewalk. This is modeled somewhat after that of Chicago, but the idea is carried out on a more extended scale; the line forms a complete circuit, running along the side of the Champ de Mars, the Quai d'Orsay, the Esplanade des Invalides, and the Avenue de la Motte-Picquet, the total length of its course being 3,500 meters. The platform is supported on an elevated structure, to which access is given from a number of stations located within the Exposition grounds. The substructure supports three platforms, one fixed and two movable, these having a speed of 8 and 4 kilometers per hour. This arrangement permits an easy passage from one to the other, and a more or less extended survey of the grounds may be made, a fine view being obtained from this elevated point. The tour is made in 26 or 52 minutes, and the fixed rate is 50 centimes. To enable the platform to pass around the curves, the different sections are dovetailed into each other by large circular portions, forming a kind of horizontal hinge. Each of the platforms carries an I-beam running along under the center; these rest upon a series of rollers placed at intervals, operated by electric motors. Upon the shaft of the motor is mounted a large roller for the high-speed platform and a roller of one-half the diameter for the slow speed. The friction of the platform is sufficient to cause its adhesion to the rollers. The platform was put into operation on April 14 and has proved a great success, as by its means an easy passage through the grounds is afforded, as well as a series of interesting views.

The great 25-ton crane which is mounted in one of the main dynamo rooms of the Paris Exposition presents many points of interest. It is of great height, being 20 meters from the ground to the highest point; it takes the form of an immense tower, formed of iron beams and braced by horizontal and oblique cross-pieces. It rolls upon a track laid along the whole length of the building, and is used to mount the large dynamos and engines of this section. The track is 6 meters wide, and is made up of two rails placed close together, leaving a space between the flanges, which is occupied by a series of short cross-pieces which constitute a rack. With this the pinion of the crane engages, the transmission being made by a stout shaft which leads from a motor placed midway up the crane. The middle space underneath the tower is large enough to afford a wide passageway, and the railroad track which has been laid to bring in the pieces of the machines passes under it, leaving still a considerable space. The tower supports a platform at the top, whose height is 12½ meters from the ground. On this is a circular crown of rollers arranged to carry the horizontal beam of the crane, which may thus take a circular motion around a pin in the center. Upon the center of this beam, which is constructed of trelliswork, are placed the motors, which separate the carriage by chains which pass over a series of pulleys. The length of the horizontal beam is 25 meters and the carriage mounted upon it will describe a radius of 11 meters. It will lift 25 tons to a height of 12½ meters. The rate of lifting is 0·04 meters per second, and the carriage travels at 0·20 meters per second; the crane is moved as a whole at the same rate. It rolls upon 8 wheels on each side. This crane has been constructed by Jules Leblanc, of Paris.

A NEW CURTAIN-HANGER.

The subject of the annexed illustration is an improved curtain pole, to which a portière or curtain may be attached without the use of the rings or pins ordinarily employed. Fig. 1 is a perspective view of the curtain-pole. Fig. 2 represents a socket employed when the pole is supported on brackets. Fig. 3 is an end view, showing the pole in position to receive a curtain. The pole has been patented by Almon S. Venen and Albert L. MacLeod, of Forest Grove, Ore.

The pole is formed of two hollow semi-cylindrical sections, hinged together at their upper ends to permit the lower ends to swing apart. Retractile springs



MAC LEOD'S IMPROVED CURTAIN-HUNGER.

serve to draw the two sections of the pole together. In order to hold the sections in distended position, toggle-links are employed, one of which is provided with a lug, which limits the downward movement of the toggles.

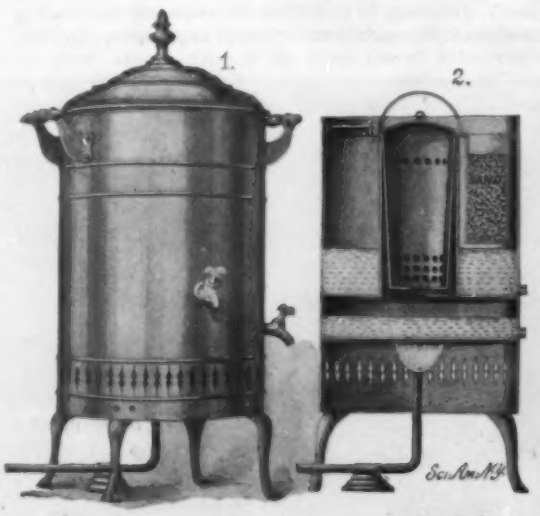
The upper end of the curtain is wrapped around a strip of wood and passed into the open pole. By forcing the links up, the retractile springs will draw the two sections of the pole together, as shown in Fig. 1.

When the pole is supported on brackets extended inward from the casing, the sections are held from accidental separation by means of a socket (Fig. 2) consisting of spring-fingers, to which an ornamental end piece is attached.

A STERILIZER FOR RAZORS AND SURGICAL INSTRUMENTS.

An apparatus for antiseptically cleaning the instruments used by barbers, dentists and surgeons, is of primary importance, for the reason that the germs in septic or infected tissues are but too easily transferred to healthy tissues by the very instruments which are used in maintaining that healthy condition. Undoubtedly the ideal sterilizing antiseptic is a moist vapor or liquid at boiling temperature, which immediately acts upon bacteria without in any way injuring the instruments. A simple sterilizer built upon this principle has been devised by Dr. J. A. Cronkhite, of the J. A. Cronkhite Manufacturing Company, 405½ South Broadway, Los Angeles, Cal.

Dr. Cronkhite's sterilizer comprises a casing formed with a heating-chamber in its bottom. Above the heating-chamber is a tank which contains an antiseptic solution, the vapors of which pass upward into a central vapor-chamber which is surrounded by a water-chamber, and which is designed to receive a conical, removable instrument-cup. In order that the



THE CRONKHITE INSTRUMENT STERILIZER.

instruments may be subjected to the action of the vapors given off by the heated antiseptic solution, the cup is provided with orifices in its sides.

Since it is often desirable to subject the instruments to the action of a sand bath, the inventor has arranged in the top of the water-chamber surrounding the vapor-chamber, a sand-vessel, into which the instruments are inserted to be mechanically cleaned before they are placed in the sterilizing receptacle.

In operation, the cover of the apparatus is removed, the sterilizing receptacle is filled with the instruments and hung in the vapor-chamber. The burners in the heating-chambers being ignited, the antiseptic solution is heated, and the hot, rising vapors sterilize the instruments, and also heat the water in the water-chamber, and hence the sand in the sand-vessel. Hypodermic syringes and the like can be directly sterilized by withdrawing a small quantity of the heated antiseptic solution and using it in any suitable manner.

The water-chamber places at the dentist's command the supply of hot water which he finds so indispensable in his work.

Automobile News.

Coke will be used as a fuel for an English motor carriage.

A Chicago firm is using an automobile provided with a steel fender.

In the Paris-Roubaix race a serious accident occurred. Two competitors on motor tricycles collided and dashed into a crowd of two thousand persons. Twenty persons were knocked down, some of them having their bones broken and many others were bruised.

Two of the largest traction engines in the world and eight steel carriages, for use in the mining district of Siberia are reported to have been shipped from San Leandro, Cal. There has also been planned a carrying service across the desert in China in competition with the trade now done by means of camels, and it is expected to have 50 engines and 3,000 wagons actively engaged within a year.

A French military paper states that Col. Renard has invented a light motor for the purpose of traction on land and sea, says The Engineer. A grant was therefore made of $4,000 in order to enable Col. Renard to adapt it for the traction of a military convoy by road. In this he has been successful, and in connection with it he has invented a stiff spiral coupling for the wagons by means of which as many as thirty wagons can be hauled by the motor, and yet be kept exactly in its wake, however winding the road may be. Col. Renard's invention will be tested at the army maneuvers this year on the plateau of Beauce.

The Russian Minister of War is desirous of purchasing a freight automobile to be propelled either by steam or kerosene, and if any manufacturer will ship two sets of carriages, one for steam and the other for kerosene, to St. Petersburg, the War Department will pay the freight and duty on both, and purchase the one best suited for its purpose, while the other one will be returned. The carriages must reach St. Petersburg by June, 1900. Full data as to weight, price, rapidity of movement, etc., should be sent to the Chief of the Staff of the Ministry of War. Owing to the fact that large orders may be given to supply the Russian army this matter is an important one.

The question of regulating the speed and circulation of automobiles has occupied the attention of the Paris authorities for some time past. The regulations which now exist have not given entire satisfaction, and the Minister of Public Works has decided to draw up a new set of rules, these to be established by a commission which has been appointed for the purpose, composed of experienced automobilists and engineers. The questions to be considered will be mainly those of speed, audible signals and the police measures to be taken relative to circulation, as well as the placing of certain distinctive marks, plates, etc., upon the vehicles. The commission includes Messrs. de Zuylen, president of the Automobile Club of France; Bailly, president of the Touring Club; Forestier, inspector general of routes; Pierre Giffard, etc. The commission has been well chosen, and out of its eleven members eight are members of the Automobile Club, and are experienced conductors.

A collection of military automobiles is to be shown at the Paris Exposition. The committee in charge of the section including the armament and material for the artillery has taken up the idea some time since, and from among the different vehicles used in the army a number of types have been chosen, to which this form of locomotion seemed to be best adapted. A number of constructors were called upon to furnish models of the different types, and a collection of twelve automobiles will be seen, of which two are operated by steam, one by petroleum, and nine by gasoline. These include a heavy tractor for use in artillery and engineering service, a medical wagon containing an equipment of surgical apparatus, medicines, etc., besides a folding tent for conducting operations. A telegraph wagon will contain a complete outfit of apparatus for field use, and another vehicle will be shown for transporting telegraphic materials. An automobile for the military postal service will also be seen. Among others are an omnibus for the transportation of personnel, a vehicle for the commanding officer, a rapid automobile and a smaller vehicle for the use of officers, a moto-cycle for the transmission of dispatches, etc. They have been built by a number of prominent constructors, such as Panhard & Levassor, the Société Scotte, Peugeot, De Dion, etc. The greater number of these automobiles will be painted a uniform gray color, which is that adopted for the army vehicles. The exhibit will be made in the Army and Marine Palace, fronting on the Seine near the Champ de Mars.

Science Notes.

Mr. Herbert Spencer, the eminent philosopher, celebrated his eightieth birthday on April 27.

Some of the railways in the South are offering special excursion rates to various points on its lines where the total eclipse of the sun may be seen. These rates are given only to passengers who go in parties of ten.

Prof. Percival Lowell and Prof. Todd have left New York with astronomical material to observe the eclipse of the sun in Algeria. Owing to the fineness of the climate of Algeria, it is a particularly good locality to observe the eclipse. There is an observatory in Algeria, the director of which recently went to Paris to take measurements with M. Lœwey in order to observe the eclipse.

In a communication made to the Société d'Ethnographie by M. Verrier, the question of the origin of the Boers has been considered. It appears that in 1652 Van Biebeck was sent by the Dutch East India Company to found a supply station at the Cape, which then changed its name from the Cape of Tempests to that of Cape of Good Hope. In 1680, there was at the Cape 600 whites of Dutch origin. When, in 1685, Louis XIV. revoked the edict of Nantes, 300 French families demanded the hospitality of the East India Company; they were sent to the Cape, where they were well received by the colonists and supplied with land and stock. They became incorporated into the colony and the Dutch language was employed exclusively. The present Boers are descendants of this colony, spreading over the territory of the Cape, Natal, Orange Free State, and Transvaal.

The Canadian government has established refrigerators for the storage of fresh bait in co-operation with associations of fishermen along the coast. Complaint arises season after season that bait is scarce just when it is most urgently needed, yet such bait can, as a rule, be obtained in abundance early in the season when the men are not in need of it. An appropriation of $25,000 has enabled the Department of Agriculture to remedy the difficulty. The Dominion government assists the fishermen's bait association to the extent of 50 per cent of the cost of building the freezers and by the payment of a portion of the cost of operating the freezers. Each local association is required to receive, freeze, and store for each shareholder a quantity of bait up to 400 pounds for each share held and to furnish it during the fishing season as it is needed. Each fisherman pays a nominal charge for freezing and storage, and the association has the option of storing surplus bait and of disposing of it on terms agreed upon by the association.

A number of experiments have been made in Australia upon the temperature of growing plants by comparison with the temperature of the surrounding air, using either wet bulbs or ordinary thermometers. The following figures have been obtained for bamboo stalks: Exterior air, 72·8° and 76·5° (Fahrenheit) as maxima and minima; bamboo, 75·8° and 89·3°. For the stalk of the banana trees, air, 63·8° and 86·1°; stalk, 75·4° and 90°. The cactus flower shows temperatures of 10° and 15° above air. Experiments were made with the cocoanut. Two of these were kept in a room for ten days, and at the end of that time they showed a temperature of 6·3° below that of the surrounding air. They were planted on the eleventh day in the shade, and germination commenced. During eighteen days the temperature remained constant, but after this time it rose rapidly and gave air, 70·6°; soil, 56·6°; nut, 83°. The same botanist has made a number of observations upon the growth of bamboo. In 37 observations he found an elongation of 47·5 centimeters in 24 hours. In 69 cases, 35 centimeters, and in 111 cases, 30 centimeters. The maximum elongation for 24 hours has been 60 centimeters, showing a rapid rate of growth.

The soil of the greater portion of the grain region of Russia and Siberia is well known in that country as the "Chernozem" or "black earth," says Bradstreet's. It is a broad belt of prairie, 600 to 700 miles inaverage width, beginning in Hungary and extending northeastward to the Ural Mountains, and then eastward into Siberia to unknown boundaries. On the north and the west are the "gray forest lands," and on the south and west are salt and alkaline districts and sandy wastes, and finally the Caucasus and the Ural Mountains. By both chemical and mechanical analyses the soil is shown to be remarkably similar to that of our own prairies, also commonly known by the similar term of "black loam." The depth is, on an average, probably a little greater than that of our prairie soil. From a chemical standpoint the soils of the two regions are similarly characterized (1) by an exceptionally large amount of thoroughly humified organic matter; (2) by the presence of an unusual proportion of phosphoric acid; and (3) by a great amount, comparatively, of lime, potash and other alkalies. These soils are, therefore, alkaline, while many others, especially of forest regions, are acid. It is well known that the substances thus more abundant in these soils than in others are just those usually needed by the wheat plant.

Engineering Notes.

A naphtha pipe line 160 miles long has been laid by the Trans-Caucasus Railway Company.

The value of Transvaal mining machinery is not far from $47,000,000. Most of the machinery (about $40,000,000 worth) is on the Witwatersrand.

A wrought iron gas main, 23,015 feet long and 3 inches in diameter, is in use between Phœnixville and Royersford, Pa. The gas is conveyed under pressure of 20 pounds.

The harbor of Port Arthur, in Manchuria, is to be excavated and a new harbor is to be built. The present channel will also be made deeper. Dredging will be done by hydraulic dredges.

A compressed air drill has proved very successful working under water on the sunken battleship of the Russian navy. The machine works as well when drilling with granite and hard substances as it does above water.

A house fell in Venice on April 21, causing the death of two people. This has naturally raised the question of the stability of buildings of this curious city. Twenty years ago one of the church towers fell down, and since then three new buildings have collapsed. In the present instance it is supposed that the clearing away of mud from the adjoining canal by means of a dredger was the cause of the accident. The drainage of Venice is fast becoming an important sanitary problem.

According to The London Engineer, the alloys used in Japanese bronzes contain a large percentage of lead, which improves the patina. The following are the constituent elements of three kinds of modern Japanese bronze: 1. Copper, 81·62 per cent; tin, 4·61 per cent; lead, 10·21 per cent. 2. Copper, 76·60; tin, 4·38; zinc, 6·53; lead, 11·88. 3. Copper, 88·55; tin, 2·42; zinc, 3·20; and lead, 4·72 per cent. Sometimes a little antimony is added just before casting, as shown by the following analysis: Cu = 68·25, Sn = 5·47, Zn = 8·88 Pb = 17·06, and Sb = 0·34 per cent.

The British Admiralty has accepted the tender of Messrs. Swan & Hunter, of Wallsend, for the new floating dock for the naval station at Hamilton, Bermuda. This dock is designed by Messrs. Clark & Standfield, who designed the United States naval dock for Algiers, La., and the Havana naval dock. It will be 545 feet long, 100 feet wide, 33 feet of depth water on blocks, and will lift 17,000 tons. It is to be built within twelve months, tested, and then towed to its destination. Its cost is to be $920,000, as against $810,000 for the Algiers dock, the latter sum included towage and insurance.

During the year 1899 21,080 patents were applied for, compared with 20,080 in 1898 and 18,347 in 1897. Of these, 7,430 were awarded after examination by the Patent Office, the corresponding number during last year having been 5,570, says The Electrician. Thus, while the number of applications only increased by 3·7 per cent, the number of successful applications increased by 33·4 per cent. During the year, 5,171 patents have expired or become void, and the total number of patents in force is 32,198. The increase in the number of patents awarded is chiefly marked in the case of electrical apparatus and machinery. Two hundred and sixty-five patents were awarded in this class in 1898, and 439 in 1899. Patents granted to foreigners are also on the increase. United States leads the way with 722, England follows with 554, France 474, Austria-Hungary 372, Sweden and Norway 99, and Russia 85.

The German Nautical Almanac, which appears for the first time in 1900, publishes the following figures, showing the progress of the merchant marine in that country. On the first of January, 1889, this was made up of 1,223 steamers and 2,482 sailing vessels, manned by 43,144 men, and gaging 2,317,523 tons. The steamers inscribed at Hamburg in 1888 numbered 688 and gaged 767,000 tons, against 348,000 in 1898, showing that the figure has doubled. The Hamburg American Company had, in 1899, 19 steamers, which transported 2,400,000 cubic meters of freight and 75,000 passengers. The company has since formed three new lines, one of which goes to New York, touching at Boulogne. At Genoa it has established a line between Italy and Argentine Republic, and has launched in one year 9 vessels, representing 77,168 tons. The German East African Company has 12 vessels, and the Waermann Company 20. The German Australian Line has 75 vessels, and has established a branch upon the Yang-tse-Kiang and along the coast of China. The German Levant Company has 20 vessels, whose transportation for 1891 amounted to 8,000,000 marks, and for 1898 20,000,000. There are also several small lines at the same port. The port of Bremen has 225 steamers and 139 sailing vessels; among the principal lines are the North German Lloyd, which has 62 steamers with 400,000 tons. In 1886 it had 30 steamers, with 99,000 tons. This line possesses the "Kaiser Wilhelm der Grosse," the most rapid of the German vessels. The Hansa Line has 38 vessels, and the Neptune 42. The Argo Company connects with London, having 30 vessels. The port of Lubeck has a total of 25 steamers, that of Flensburg 17; Keil has 14 and Stettin 81.

Electrical Notes.

A high-speed electric railway is to be built between Brussels and Antwerp, a distance of 28 miles.

Cables have been laid from Cape Town to St. Helena and from St. Helena to the Ascension Islands, and from there to St. Vincent, consequently there is a complete cable route to South Africa by way of Maderia and St. Vincent.

The locomotives on the Northern Pacific Railroad are equipped with electric headlights, and incandescent lights are also provided on the under side of the running boards and beneath the boiler, thus enabling the engineer and firemen to examine any part of the machinery with ease.

A telegraph line from Syria to Hedjaz is contemplated. This will give access to that portion of Arabia, thus bringing Mecca and Medina into communication with the world. The line will follow the old pilgrimage route to Mahomet's shrine at Mecca; the total length of the line is said to be 931 miles.

The London fire brigade is to have installed and maintained for two years wireless telegraphy instruments to connect the fire station at Streatham Green and a temporary sub-station in Streatham. It seems a very curious use for wireless telegraphy when ordinary fire alarms or telephones would answer the purpose.

A number of years ago a telegraph cable was laid in the bed of the Amazon River to connect the various towns along that stream with Para. The driftwood, etc., brought down by the stream broke and interfered with the workings of the cable to such an extent that it has been in use only a short time since it was laid. A land line is now being built and 180 miles have been completed. The difficulty of building a telegraph line through the Amazon forests is enormous, and it would not be surprising if this proves to be the most expensive telegraph line in the world.

The electrophone appears to be rapidly coming into favor in England. Already there are many places in the leading thoroughfares of London, where one can enter, and by the payment of a small fee, be switched on for a quarter of an hour to any of the principal theaters, music halls, etc. Now the Duke and Duchess of York have had their residence, York House, connected by electrophone with the leading theaters, concert halls, and so forth, so that their Royal Highnesses may listen to the entertainments and also enjoy the operatic performances at Covent Garden.

A method of testing the comparative efficiency of heat insulators was lately described in the "Proceedings" of the Royal Society. The authors are Messrs. C. G. Lamb and W. G. Wilson. The following results were obtained:—Air (no baffle plates), 0·000200 conductivity; pine sawdust, 0·000242; pine shaving 0·000162; brown paper (crumpled up), 0·000167; hair felt (broken up), 0·000145; hair felt in two sheets, ½ inch thick each, 0·000106; dry asbestos, 0·000297; charcoal, 0·000150; sand, 0·000740; rice husks, 0·000150; kapok (a heat insulator), 0·000144; kapok (loose), 0·000123; silicate cotton 0·000151.

The address of Sir William Henry Preece on "The Relations between Electricity and Engineering," which is published in the current issue of the SUPPLEMENT, contains abundant food for thought. He says there are four great principles underlying the practical application of electricity; the first, the establishment of a magnetic field; second, the establishment of an electric field; third, the disturbance or undulation of the ether; and fourth, the work done by the generation and maintenance of electric currents in material systems. He gives some very interesting facts in his lecture, such as the following: He has recommended aluminium wire for use in the interior of Africa where transportation is so costly. The same conductivity can be obtained as with copper with half the weight and at a less price, and a line can be put up which is telegraphically ten times better than of iron for less money.

A remarkable case of death by lightning occurred last Easter Monday during a football match in England. When the rain poured down many of the spectators took refuge in the grand stand. Suddenly the building was struck by lightning the electric fluid splintered the flag staff from top to bottom in its progress. One young man was killed instantly, and some thirty others were severely injured. The hat of the young man who was killed was partially burned, the crown was torn off, and the lining wrenched out. His hair was burned off, and the metal collar stud he was wearing at the time was compietely melted, making a superficial wound in his neck. He was badly scorched about the body, and down his right leg, the trouser of which was torn, and the right boot split and burned. He had several coins in his right trousers pocket all of which were fused into one solid lump of metal. Curiously enough the gentleman standing beside him experienced no effects of the shock. Needless to say the building was not equipped with a lightning conductor, such a provision probably being considered as unnecessary in this case since the stand was not very tall.

MANUFACTURE OF GUNS AND ARMOR AT THE BETHLEHEM STEEL WORKS.

I.—THE OPEN HEARTH PROCESS.

Among the industrial establishments in this country which will always be associated with the history of the modern United States Navy, none will merit more honorable mention than the vast assemblage of forges, furnaces and machine shops, many of them the largest of their kind in the world, which have given the historic town of Bethlehem a new lease of life and a world-wide reputation.

The relation between a country's navy and the establishments which provide its ships, guns, and armor is, or should be, one of mutual helpfulness. Without such institutions as the Carnegie and the Bethlehem Steel Works, and the shipyards at Philadelphia, Newport News, and San Francisco to produce ship plates and forgings and assemble this material in the completed and fully equipped fighting ship, the task of reconstructing our navy, commenced in 1883, would still be in its initial stages; on the other hand it is the needs of the navy and the expected recurrence of orders for material that are answerable for the lavish scale upon which some of these industrial establishments have been laid down, enlarged and furnished with costly equipment. They are mutually dependent. This is specially true of the Bethlehem Steel Works, which, in preparation for the needs of the future, has built what is probably the most complete plant devoted almost exclusively to the manufacture of guns and armor to be found in any country of the world. The Bethlehem Steel Works are located upon a strip of land which is about a quarter of a mile in width and extends for a mile and a quarter along the banks of the Lehigh River. The whole of the yard is served by some nineteen parallel railway tracks, which make up, including broad and narrow gage, a total of thirty-five miles. The various forges and armor plate and machine shops are located throughout the yard in such relation to each other and to the railways as conduces to economy in transportation and handling—a most serious consideration when we bear in mind that single masses of gun steel and armor plate that are being handled at this works will weigh as high as 137 tons, and that every one of these heavy forgings has to be handled and transported fully twenty times in the Harvey process, and no less than fifty times in the yet more costly Krupp process. The buildings themselves are truly colossal, as will be seen from the following list of the largest of them, which includes an open hearth building, 1,950 feet long by 111 feet wide, a machine shop, 1,875 feet by 116½ feet, an armor forge, 850 feet by 116½ feet, a carbonizing department in which the face-hardening of the armor is carried out, 700 by 63 feet, and an armor plate machine shop, 610 feet long by 124 feet wide. There are many other subordinate building which, while they would be mentioned for their size in a description of most establishments, are relatively insignificant compared with the huge structures above mentioned.

The genesis of the open hearth process which forms the subject of the present article is to be found in the stock yard, in which the material that is to be melted down in the open hearth furnaces is stored, and the "mixture," as it is called, made up in its proper proportions for charging the furnaces. In the open hearth process wrought iron or steel scrap are melted with cast iron in such proportions as to reduce the percentage of carbon to that required for the particular grade of steel which is being manufactured. Hence, it is necessary that the composition of every pile of pig iron and iron and steel scrap in the stock yard should be accurately known; and to this end the scrap which is brought from the various forges and machine shops throughout the works is stacked in separate piles and its composition carefully recorded. The stock yard is, in itself, a most interesting study. In one pile will be seen the massive ends which have been cut from steel ingots at various stages of the forging process. In another pile may be seen the turnings from the heavy lathes and milling machines in the gun and armor plate shops. Elsewhere may be seen a train of charging boxes full of "skull scrap" from the casting pits, while adjacent to the scrap piles are located the bins from which the ores, of which a certain amount is used in the bath for decarbonizing, are taken to add their quota to the mixture. In our engraving of the stock yard will be seen a train of cars upon which are loaded the "charging-machine boxes," open rectangular boxes which are loaded with the mixture, and hauled up an inclined plane onto the charging platform in front of the open hearth furnaces. Here they are picked up, one at a time, by an electrical charging machine, which is provided with a massive extensible arm that hooks into the charging box, raises it from its car, thrusts it into the furnace, turns it completely around, thereby discharging its contents, and afterward withdraws it and places it empty on the truck. The charging machine is a most powerful affair, as will be seen from the fact that it can lift a dead weight of 7,000 pounds at the end of its 20-foot arm, and hold the weight out literally at "arm's length," handling it apparently with the same ease with which one handles a cupful of water.

ELECTRICAL CHARGING-MACHINE EMPTYING A 7,000-POUND BOX OF MIXTURE INTO THE FURNACE.

Before proceeding to a detailed description of the furnaces, it will be well to state that the open hearth process is used exclusively at the Bethlehem Steel Works, and no Bessemer steel whatever is made. While Bessemer steel is admirably suited for steel rails and structural material for buildings and bridges and for shipbuilding, it has not hitherto been possible to secure by this process the high qualities which are demanded in all specifications of gun steel and armor plate. The superior results obtained with this process are due to several causes, but chiefly to the fact that the process of decarbonizing in the open hearth process being greatly protracted, it is possible to make a large number of successive tests and stop the process at the moment when the steel in the furnace has reached the exact composition required. In the Bessemer process the decarbonizing is accomplished by pouring the molten metal into a converter and blowing air through it until the whole of the carbon and most of the sulphur, phosphorus and silicon have been burnt out, when a certain amount of spiegeleisen is added to bring up the percentage of carbon to the desired point. The Bessemer "blow," as it is called, occupies twenty minutes only, and should the blowing be extended beyond the moment at which decarbonizing is complete, the metal will be burnt, with subsequent injurious effects to the steel. The open hearth process, on the other hand, occupies from eight to twelve hours; and it is possible to know at any time just exactly what are the conditions of the heat and what chemical changes are taking place. Moreover, the temperature can be most carefully regulated.

The distinctive qualities which are sought in the manufacture of gun steel and armor plate are obtained by varying the composition of the mixture, by the method of treatment in the furnace, and by subsequent treatment of the cast ingot by fluid compression, forging, tempering and annealing. The requisite properties for the gun steel furnished to the government are hardness, to enable the guns to resist the wearing action of the projectiles and the erosion from the powder gases; toughness, to enable it to undergo change of form without fracture; elasticity, to enable it to give under enormous pressures, and yet return to its original dimension, and a high, though not an excessive, ultimate breaking strength. For armor plate the desirable qualities are extreme hardness, particularly at the face, combined with great thoughness throughout the whole body of the plate. The latter quality is secured in the Harveyized armor by the introduction of a certain amount of nickel, and in the Krupp armor of other elements during the furnace treatment; while in both types of armor the hardness and the toughness are enhanced by a most elaborate system of forging, tempering and annealing, which in the case of the Krupp plate, has no parallel in the whole range of the industrial arts. The open hearth furnace, with its regenerators, is a most elaborate and costly construction. The furnace proper consists of a large dish-shaped structure, lined with refractory sand, into which the mixture is loaded by the charging machine already referred to. The furnace is heated with producer gas, manufactured by burning coal in air-tight ovens, which are fed with air under pressure in an insufficient amount for complete combustion. The resulting carbon-monoxide gas passes through large regulating valves, located below the charging platform, then through a mass of firebrick checkerwork, and finally enters the side of the furnace through the lower flue, shown in the engraving. Air is admitted by way of the valves, and passes through

The scrap from the various forges and machine shops is brought to this yard, and stacked according to its chemical composition. Here the "mixture" is made up in boxes and carried on cars to the open hearth furnaces.

THE STOCK YARD AT THE BETHLEHEM STEEL WORKS.

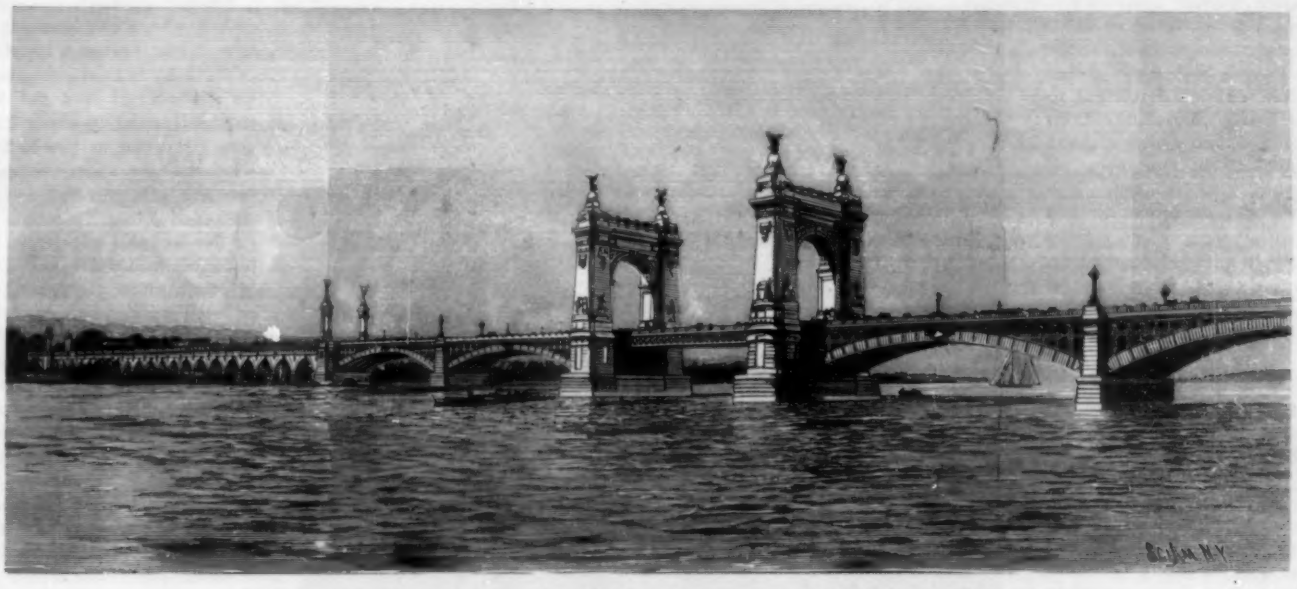
another mass of checkerwork built up alongside the first-named mass, and is conducted to the furnace by two flues, which are located on each side of and above the gas flue. Here the gas and air mingle and combustion takes place at extremely high temperatures, ranging from 2,700° to 3,000° F. The products of combustion pass over the charge and out at the opposite side of the furnace, and through a set of flues and checkerwork exactly similar to those through which the gas and air entered, raising the checkerwork to a high temperature. About every twenty minutes the lever controlling the regulating valves is thrown over and the gas and air are directed through the now heated checkerwork and flues on the left-hand side of the furnace. Here they are regenerated to from 1,500° to 1,800° F. The flow of gas is reversed every twenty minutes during the ten to twelve hours occupied by the process.

It takes about six and a half hours to melt the charge, and four to six hours are consumed in boiling down to get rid of the carbon and various impurities. As soon as the heat is melted, samples are taken from the furnace and carefully analyzed, and these tests are repeated at frequent intervals until the heat is ready for casting. One of the views shown on our front page is taken at the back of the open hearth furnace above the casting pit and shows the process of casting. As soon as the steel has reached its proper composition, a tap hole is opened and the steel is run off into the large ladles, which are shown in the engraving, from which it is run into the molds by opening a tap hole in the bottom, which is ordinarily closed with a plug of fireclay. In all of these castings a considerable excess of metal, known as the "sinking head," is formed at the top of the mold, which serves the double purpose of compressing the lower portion of the ingot, increasing its density, and closing any cracks or holes which might form during cooling. It also serves to collect the impurities in the metal, which rise by their lesser gravity to the surface. The metal which is to be worked up as gun steel, is subjected to hydraulic pressure in what is known as the fluid compression process, a description of which will be given in a succeeding article; but a few of the largest castings for gun steel and all of the armor plate castings, on account of their great size, are cast direct in the form of massive ingots. One of our illustrations represents the great 100-ton ingot which was cast for the manufacture of the 16-inch army gun, which is now nearing completion at the Watervliet Arsenal.

MOLYBDENITE is proving to be of value in the manufacture of steel. The present market valve in Pittsburg is $200 a ton.

PROPOSED NATIONAL MEMORIAL BRIDGE ACROSS THE POTOMAC AT WASHINGTON.

The Secretary of War has just accepted the final plans for the proposed Memorial Bridge to be built across the Potomac to Arlington. The successful winner of the competition is the well-known bridge engineer, Prof. W. H. Burr, of the Department of Civil Engineering of Columbia College, New York. Four prominent bridge constructors, namely, Prof. W. H. Burr, George S. Morrison, Leffert L. Buck and William H. Hutton, all of New York city, were especially invited by the Secretary of War to compete for the honor of designing the Memorial Bridge. The designs and drawings were to be paid for in their order of merit as recommended by the Board of Engineers, as follows: For No. 1, $1,200; No. 2, $1,100; No. 3, $1,000; No. 4, $900. The designs and drawings were then to become the property of the United States.



PROPOSED NATIONAL MEMORIAL BRIDGE ACROSS THE POTOMAC AT WASHINGTON.

The selection of the design marks an important step in this commendable project, which contemplates the spanning of the Potomac River between the government reservations at Washington and Arlington with a monumental structure which shall form a fitting national monument to American patriotism in its highest and broadest sense.

The specifications called for the presentation of two designs, one for a bridge with a draw opening and to provide for street cars as well as for ordinary vehicles and pedestrians; the other for a bridge with draw opening, but without provision for street cars, etc. After full consideration of the various plans for the bridge and approaches, including the architectural features, ornamentations, cost, etc., the board concluded that the general design of Mr. Burr should be designated as first in the order of merit and should be adopted, subject to a few modifications, such as width, slope of roadway, towers, provisions for tramcars, and such other minor modifications as might develop during the progress of the work.

The main features of Prof. Burr's design No. 1 are as follows: The whole structure, with the exception of the bascule over the main channel, will be of arched construction, and will consist of the bridge proper over the river channel, and a long approach at either end; the four main arches and bascule which constitute the former being constructed of steel and the approaches of masonry.

The design is for a double deck bridge, 60 feet in width between railings, providing for two sidewalks, each 10 feet wide, and a roadway 40 feet wide. A double-track street railway is provided for upon the lower deck. The total length of the openwork of the bridge proper and approaches will be 3,440 feet. The bridge is to consist of two 283-foot steel arches, one steel draw span having a clear width of 213 feet, and two more 283-foot steel arches. The draw-span has two bascule arms supported on trunnions, balanced by rear extensions and counter-weights. The clear opening is about 167 feet, and the span from center to center of trunnions, 235 feet. The floor is to be of asphalt cork block. It is proposed to operate the draw by electric motors. The bascule and the adjacent piers are to be built on bed rock by the pneumatic process, the caissons to be filled with concrete; the other piers are also to be founded upon bed rock and built up within cofferdams. The 283-foot steel arches are segments of a circle, the springing line being 24 feet above mean low water. The Washington approach is to consist of fifteen 46-foot spans, masonry arches, back of which is an earthen embankment, 500 feet long. The Arlington approach will consist of twenty-one 46 foot masonry arches, approached by an earthen embankment 1,500 feet long. The principal divisions of the bridge are marked by massive masonry arches and towers, decorated with emblematic groups of statuary, etc., commemorating men distinguished in the foundation and development of the Republic. The cost of the structure is estimated at $4,083,850.

ALEXANDRE III. MEMORIAL BRIDGE, PARIS.

ALEXANDRE III. MEMORIAL BRIDGE, PARIS.

The Pont Alexandre III., though completed, was not relieved of unsightly superstructures until a day or two prior to the official opening of the Paris Exposition. As it stands today, this superb bridge, with its four lofty towers, each surmounted by a golden Pegasus that glitters in the sunlight, forms the connecting link between two new sections of the city and the Fair, the fame of which will soon be world-wide. The new

avenue, cut through from the avenue of the Champs Elysées and flanked, on either side, by the only permanent buildings of the Exposition, forms the approach to the bridge from the right bank of the Seine.

Leaving the bridge on the left side of the river, the visitor at once beholds the snowy whiteness of those exquisite palaces, on either side of the Esplanade des Invalides, that are devoted to exhibits of the Decoration and Furnishing of Public Buildings and Dwellings. These structures are exquisitely frescoed.

From the center of the bridge, looking right and left, or from either end it, vistas of rare architectural beauty can be obtained.

The bridge has been constructed so as to preserve an uninterrupted perspective, the table of the bridge having been depressed as much as was possible without detriment to navigation on the Seine. Metal has been employed in its construction, giving a great depression, with a platform thickness reduced toward the middle of the arch. The substructure is composed of fifteen arches of cast steel.

A detailed and fully illustrated description of the construction and engineering features of their handsome structure was given in the SCIENTIFIC AMERICAN of March 10, 1900.

To prevent any effect of contraction or dilation of this enormous mass of metal, in any variations of temperature, the arches are joined to the key in a manner that has been seen in the Galerie des Machines and the older bridge Mirabeau.

The massive masonry forming the heads of this noble bridge, adorned with magnificent towers, visible from many distant points of view, constitutes an enduring monument to Messieurs Résal and Alby, engineers in charge of the work.

The laying of the foundation stone of the Pont Alexandre III., formed the most imposing event of the late memorable visit of the Czar and Czarina, to Paris, particulars of which are still fresh in the public mind.

The total cost of this great work has been 7,000,000 francs, 1,000,000 having been spent on the decorations alone.

A PAIR OF CURIOUS RELICS AT ABERFOYLE, SCOTLAND.

In the earlier half of the century the practice of stealing bodies from the churchyards where they had been interred, for the purpose of sale as subjects for dissection, which was known as "body-snatching," was for a time very rife.

Various plans were made to defeat the nefarious and sacriligious proceedings of the "body-snatchers" or "resurrectionists" as they were sometimes called, a very common one being the erection of two or more small watch-houses whose windows commanded the whole burying ground and in which the friends of the deceased mounted guard for a number of nights after the funeral.

A usual method of the grave-robbers was to dig down to the head of the coffin, bore in it a large round hole by means of a specially constructed center bit and haul the body to the surface with a hook-rope. It was to counteract this maneuver that the two curious coffin-like relics now lying on either side of the door of the ruined church of Aberfoyle in Perthshire, were constructed. They are solid masses of cast iron, and, as may well be imagined, of enormous weight. On the upper side of each are provided two loops or handles.

When an interment took place one of these massive slabs was lowered by suitable derricks, tackles and chains onto the top of the coffin, the grave was filled in and there it was left for some considerable time. Later on the grave was opened and the iron armor plate was removed and laid aside ready for another funeral.

Although these contrivances have not been used for many years, they still lie on the grass of the lonely little church yard, objects of curiosity to the passing cyclist and tourist.

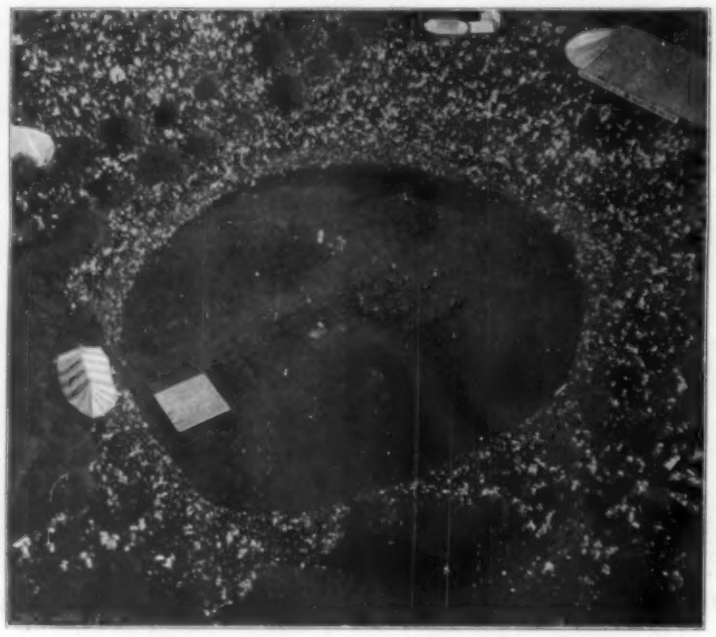
A SUBMARINE cable in actual use will form one of the exhibits of the Paris Exposition. It will run from the Electricity Building to the Vincennes Annex several miles distant along the Seine. A complete cable station will be operated at each end to show the public how trans-oceanic messages are transmitted and received. Souvenir messages may be sent by the public.

AERIAL PHOTOGRAPHY.

BY F. A. A. TALBOT.

We present herewith an interesting photograph which was taken from the car of a balloon in England, at a height of 300 feet. It was taken with an ordinary magazine camera, carrying some forty films, by a well-known aeronaut of London.

Aerial photography appears simple enough from a cursory point of view but the operator who manipulates his camera from the car of a rising balloon has many difficulties against which to contend, that do not present themselves to the photographer who plies his work on terra firma. In the first place, it is imperative that the camera should be provided with a rapid lens, which also possesses long range, and yet gives clear and sharp definition. Again, the magazine contrivance must be of the simplest, quickest, and most reliable description, since one has but very little time to change the plates. When a balloon leaves the earth its upward flight at first is often at the pace of 500 feet per minute, gradually decreasing until it attains its equilibrium. It will be seen from this fact that the operator has to be a very quick worker. The plates must be of exceptional rapidity, since the exposure must be remarkably short; otherwise the resultant photo will be blurred. Cases have been known in which a shutter working instantaneously at the one hundredth part of a second has been too slow, though it would have been quite rapid enough to snap an express train traveling at 60 miles an hour; but in such cases the velocity of the rising balloon has been exceptional. The photographer has no need to trouble about his view-finders. He simply points the camera downward, in the desired direction, and snaps his shutter as rapidly as he can work.



Height, 300 feet. Time, near sunset. Note the clear definition and long shadows.

BALLOON ASCENT, FROM THE AERONAUT'S POINT OF VIEW.

But aerial photography is full of disappointing failures. The aeronaut who secured the accompanying photograph has, on several occasions, ascended in a balloon with his camera fully loaded with forty films, and has exposed the whole of them at varying altitudes; yet when they were developed they were found to be absolutely useless. The atmosphere plays an important part in the success of an aerial photograph. At an altitude of 300 feet a magnificent result may be obtained. You ascend another 100 feet, and expose a second plate, exactly under the same conditions regarding speed, light, etc., as the first, yet the plate ultimately turns out a dismal failure. The exposure proves to be many seconds too short, and the picture is scarcely visible upon the negative. But ascend another 200 or 300 feet, expose again, and you get a result equal in every respect to that obtained at an altitude of 300 feet. There seems to be a thin filmy cloud (not of vapor), that floats above the earth, which appears to have a non-actinic effect upon the plate, and therefore it is under exposed. This phenomenon is apparent to the naked eye.

The accompanying illustration shows the crowd who have watched a balloon ascent. It was snapped at a height of 300 feet, and everything is as sharp and distinct as could be desired. It was not taken under the most advantageous conditions, since the sun was low down in the heavens—see the long shadows cast upon the ground—and therefore the light was inclined to be a little yellowish in color. As a rule an aerial photo is rather flat and uninteresting, owing to the lack of half-tones and shadows, but this photograph is full of life and vigor.

ARMOR-PLATE FOR COFFINS—A RELIC AT ABERFOYLE, SCOTLAND.

Phosphate Deposits in Christmas Island.

Christmas Island is situated 190 miles south of Java, being 12 miles long by 4 to 9 miles wide, having an area of 43 square miles. Its climate is favorable, the temperature varying from 20° to 30° C.; the soil is very fertile, and contains from 8 to 30 per cent of phosphate of lime. The trees have a remarkable development; in some places the sago palm reaches a height of 60 to 70 feet. Among the representants of the fauna and flora of the island are a few species which exist nowhere else; for instance, a bat of unusual size, which flies in bright sunlight, an owl whose cry resembles the barking of a small dog, and a terrestrial crab which climbs trees, etc. The first mention of this island dates back to 1666, when it figures upon the maps of the time under the name or Moni; on later maps it is called Moni or Christmas Island. The great difficulty encountered in landing and in mounting the heights prevented, for a long time, the thorough exploration of the island. In 1888 the "Challenger" expedition made a landing and devoted ten days to a thorough exploration; paths were traced to the summit, and a great many specimens of minerals as well as of the fauna and flora were sent to England. Among the minerals, the samples of rich phosphates attracted attention and led to a more thorough investigation; a fresh supply of specimens was obtained, and it was found on analysis that the percentage of phosphates reached as high as 80 to 92 per cent.

Mr. Andrews, who was sent to the island to study the phosphate deposits, considers them to be formed by the accumulation of excrements of myriads of sea birds which inhabited the island, which was formerly low and free from forests. Several years ago Mr. Murray of the "Challenger" expedition, and Mr. George Ross established themselves on the island and secured more than 200 specimens, which they had analyzed. The Christmas Island Phosphate Company was formed, which worked a part of the deposits, especially that of the phosphate hill, where a railroad was built to the point of disembarking 1¼ miles distant, and special loading apparatus was erected. Several shipments have been made to London, the amount reaching 6,000 tons, and the results having proved satisfactory, they will be continued. The British Museum has recently published a series of observations relating to the geological formations and the fauna and flora of the island, which have been obtained by Mr. Andrews and others.

FOR several years Prof. Omori has studied the subject of earthquake measurement in a brick building, says Nature. One of Prof. Ewing's horizontal pendulum seismographs was fixed near the top of an external wall of the Engineering College at Tokyo, while another was erected on the ground below. During the years 1894–98, ten moderate earthquakes were recorded, and it was found that if the earthquakes consisted of comparatively slow vibrations (say, above half a second in duration), the motion was practically the same in both places; but if of quick-period vibrations, the motion of the top of the wall was about twice as great as that of the ground. Prof. Omori notices that, with destructive earthquakes, the damage of two-storied buildings is generally confined to the upper story.

GOLD DEPOSITS AND MINING METHODS AT CAPE NOME.

Cape Nome Mining District, generally speaking, includes that portion of the north shore of Norton Sound extending from the eastern extremity of Galooin Bay west for a distance of about seventy miles. The tundra, which is so novel and marked a feature of the region borders on the sea and extends to the foot hills. Sometimes the tundra is seven miles in width and underlying it at an average depth of five feet are the deposits of coarse black sand which contain the gold. Practically, the sand beneath the tundra and on the beach is identical, and some careful observers assert that the tundra has been formed by the sea which at times past extended over the flat and has gradually receded leaving the deposits of gold-bearing sand in their present position.

The more confident opinion is that these deposits are clearly of glacial origin which, in a diminutive way, can be observed at times of breaking up of winter, when the ice cakes of the streams invariably bring down loads of gravel which is deposited as they are dissolved by the heats of summer. This theory is responsible for the general belief that the deposits of gold-bearing gravel cover the entire floor of Norton Sound. This will be proved during the present season as a number of marine dredgers are preparing to work the territory as soon as the ice obstructions disappear.

As to the origin of the golden sands of Cape Nome, or the source from which they were derived, there is absolutely no information. If of glacial origin they would seem to have been transported from a distance, and this supposition is considered more probable from the fact that the flakes and nuggets so far found are distinctly sharp or angular in shape. They show few indications of the effects of erosion or friction, as would have been the case had they been washed down stream. In any event the gold deposits were not brought from any section near to Cape Nome, as explorations for a distance of 240 miles northeast and in the range between Kolzebue and Norton Sounds do not, as yet, show the existence of quartz deposits. Quartz has been found, but barren of gold. The bed rock in all this region is rarely over 7 feet below the surface, often much less. In this distance have been found no less than four different layers of gravel. In all the world there is nothing resembling these Cape Nome sands. The well known black sands found on the ocean shores in California, Oregon and Alaska, some of them yielding prolifically, are clearly deposits in channels of dry mountain streams, easily traced and well defined, but at Nome the gold-bearing gravel is spread in blanket form over a wide extent of country, the boundaries of which are not yet established.

The total output for the Cape Nome region has been segregated by the statistician of the United States Branch Mint at San Francisco, and amounts to $2,400,000. This, for the first season, the product almost entirely of the most primitive methods, is conclusive of the extraordinary richness of the new fields.

With an early start and the aid of mechanical appliances of high efficiency, such as will be introduced this season, it is certain that a very great increase in the product will be the result.

The extraction of gold from the auriferous gravel at Cape Nome is effected by the methods common in all placer deposits of the Pacific Coast, though the application of heat to disintegrate the sands, as in the Klondyke, is not necessary.

Every mechanical device used in placer mining is an amplification of the primitive pan or rocker, so successfully employed by the early miners in California. These machines were used at Cape Nome last summer, and by their aid $2,400,000 was extracted. They are all of limited capacity, and their operation fatiguing, and, moreover, wasteful. In the Arctic regions where the seasons are so short, something more efficient is required, and invention has been stimulated to overcome the unfavorable conditions existing, and to produce a machine which would increase by a hundred times the capacity of the rocker, reduce the cost of running to the minimum, and at the same time do the work more effectively and save waste or loss. Economy in power, in help fuel, quicksilver and water, is a necessity, if such a machine is to meet requirements; and to these qualifications must be added compactness, strength, and a construction so simple that parts may be easily duplicated.

A large number of inventions have been offered and some of them meet most of the requirements; but the majority, while theoretically correct, are not practicable. All, without exception, endeavor to mechanically repeat the movement given to the pan in manual washing.

They are driven by hand or steam power and generally consists of a hopper to which the sand is raised by pump or shovel. A stream of water washes the sand down over the riffles, which oscillate rapidly, the gold collecting and being amalgamated by the mercury and amalgam lying between each. The rough gravel is thrown outside in the process.

We present an illustration of one of the most successful power machines, designed for the Alaska beach mines to meet the requirements indicated above. It is known as the Drake Amalgamator, and is manufactured by the Krogh Manufacturing Company, of San Francisco, Cal. It is carried in a stout timber frame and measures about 4½ feet square by some 6 feet in height. For successful operation it requires about 20 per cent water to 80 per cent of sand, and its capacity, as determined on the Cape Nome deposits, is 6 tons per hour, gross.

VERTICAL SECTION OF A CAPE NOME CLAIM.

TYPICAL GOLD-SAVING MACHINE FOR BEACH MINING AT CAPE NOME.

At the top of the frame is a hopper into which the sand and gravel are shoveled, and from the hopper a worm feeds the material, at a constant rate, to the upper end of a shaking frame, where water washes it down. The shaking frame consists of two adjustable tables, one above the other, each of which may be set to the desired grade independently of the other. The upper table is a steel punched slot screen of ½-inch mesh, which ends in three riffles which are formed by means of 1-inch cleats fastened across the lower part of the table. It is in this lower part that the coarse gravel is separated, and if there are any nuggets in the sand they are caught by the three riffles. The fine sand and the water flow through the screen which forms the upper part of the table, and fall through upon an inclined piece of sheet steel, which carries the material to the head of the table below. This table consists of forty-eight cross-riffles, 1 inch square, arranged in sections of eight, and filled with sufficient quicksilver to cover the bottom. The tables are both given a lateral oscillation by means of two eccentrics carried on a shaft attached to the side of the frame as shown in the illustration. It is considered by the inventor that the best grade at which to set the table is one of 2½ inches in 4½ feet, with a running speed of 350 revolutions per minute. It will be seen that the machine combines the riffle boards of the ground-sluice and the side-shaking of Frue vanner concentrator. It is claimed that at the most not more than one-tenth of a horse power is necessary to run this machine. The total weight of the amalgamator set up is a little over 800 pounds; but for convenience of transportation it is constructed so that no piece weighs over 100 pounds.

Russian Experiments in Electro-Culture.

Some Russian scientists have been trying some interesting experiments in electro-culture. One of them ascertained that electrified seeds germinated more rapidly, and gave better and quicker results than seeds which have not been submitted to preliminary electrification. He also repeated the experiments of Ross, that is, burying in the soil one copper and one zinc plate placed vertically and connected by a wire. He found that potatoes and roots grown in the electrified space gave crops three times heavier than those which were grown close by on a test plot: the carrots attained quite an unusual size of from 10 to 12 inches in diameter. The other Russian scientist tried a series of experiments that were more original; on his experimental plot he planted wooden posts about ten yards apart, which were provided at their tops with metallic aigrettes connected by wires so that the plants were cultivated under a sort of network of wire. He obtained some remarkable results and ripening barley was accelerated by twelve days. A series of laboratory experiments upon boxes of soil was also made. The temperature of the soil was raised by these currents; its moisture decreased at first, but began to increase after a course of three weeks, and at last the amount of vegetable matter in the soil was increased by the electric currents. Further researches seem promising.

The May Building Edition.

The Building Edition for May is a most interesting number of this periodical. It is filled with engravings of houses of various prices, and it also has several attractive features such as "The Breakers" at Newport, R. I. The new buildings at Stanford University are also illustrated and described. There are several pages of reading matter devoted to the subjects germane to the interests of the periodical. By mail, 25 cents. Munn & Co., Publishers.

The Current Supplement.

The current SUPPLEMENT No. 1272 is of unusual interest. The "Opening of the Paris Exposition" was written by our special correspondent, and is illustrated by engravings showing interesting features of the inauguration; it is also accompanied by maps showing the location of the various buildings. "Portable Pneumatic Tools" is an illustrated article describing the principal types of these important tools. "Pneumatic Malting" describes a new and important process of malting. "Liquid Hydrogen" is a most important lecture delivered by Prof. James Dewar before the Royal Institution. "The Relations Between Electricity and Engineering" is a lecture by Sir William Henry Preece. "The Means of Defense of Animals" is a lecture by Philip P. Calvert, Ph.D., of the University of Pennsylvania and has been revised by the author especially for the SUPPLEMENT. "The Shrinkage of Lake Nicaragua. A Question of the Permanancy of the Proposed Nicaragua Canal" is by Prof. Angelo Heilprin, F.R.G.S., Professor of Geology at the Academy of Natural Science, Philadelphia. It is a most important and authoritative paper and is referred to elsewhere in this issue.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

STACKING-ATTACHMENT FOR THRESHING-MACHINES.—FRANK HARTLEY, Hartland, N. Y. This strawstacker, capable of being attached to any threshing-machine, is provided with a turn-table which can be operated to move the stacker from an extreme right to an extreme left position. The operator, standing on the ground, beside the thresher, can turn the hood in any direction and lengthen or shorten the delivery or discharge-tube. Ball or roller bearings are used to reduce friction.

PLOW ATTACHMENT.—JOHN E. JONES, North Bridgewater, N. Y. The invention provides a simple means for preventing the plow from jumping out of a furrow should the point strike an obstacle. Rollers are employed, one forward and one rearward of the share, which can be simultaneously raised or lowered, the mechanism employed being controlled by the movements of the animals hitched to the plow.

HARROW-TOOTH AND CLAMP THEREFOR.—WILLIAM M. BAKER, Fortville, Ind. A simple device has been conceived whereby teeth can be adjustably and securely fastened to the frame of the harrow. The tooth is provided with a number of recesses designed to engage the forward wall of the upper slot of a clamp. The tooth can be adjusted by causing the proper recess to engage the upper slot-wall and can be secured in adjusted position by tightening the clamp-screw.

Engineering-Improvements.

VALVE-GEAR.—ALFRED WETZEL, Charlottenburg, Germany. There are separate channels for the inlet and outlet of steam, and, consequently, separate means for opening them. All the valve-gear parts are outside of the cylinder. The inlet-valves are opened by springs secured to the piston; and adjustable springs are employed for pressing the inlet-valves upon their seats for the purpose of regulating the inlet of steam. The valve will be closed when the piston reaches a position farther away from the beginning of the stroke than that at which the valve was opened, for the reason that the steam pressure upon the one side of the valve is counteracted by that upon the other side and that the valve offers a certain resistance.

LUBRICATOR.—HARRY R. WHITE, Hartford, Conn. The lubricant-feeder is especially designed for use on locomotive-engines. It comprises a cylinder in which a piston moves. A chamber is connected with the cylinder for receiving oil and steam. A delivery-chamber is connected by a bore with the receiving-chamber. A carrier-valve moving with the piston, extends in the bore, and is arranged to receive oil from the receiving-chamber and to carry it to the delivery-chamber.

Mechanical Devices.

BLACKBOARD-ERASER-CLEANING MACHINE.—ROBERT J. RILEY, Lafayette, Ind. The cleaning of erasers is ordinarily effected by knocking the pads against any convenient object. The chalk-dust which fills the air is unfit to breathe. The inventor has devised a simple machine, which is to be placed in the basement or or open air, and which, in a few minutes, will thoroughly clean the erasers without the annoyance of dust. The machine comprises an overhanging, laterally-swinging bed for holding the erasers, a series of beater-arms, and a rotary shaft with wiper-arms or cams for drawing the beater-arms away from the erasers. Independent springs for each beater-arm, throw the beater-arms with independent forceful blows against the erasers.

STRAIGHTENING AND DRILLING MACHINE.—JAMES R. NEILSON, Delamar, Nev. The machine is designed to straighten rails, axles, pipes, and the like, and to drill holes in rails for fish-plate bolts. The frame is U shaped and is provided with ends for engaging an article at spaced points. A tubular bar slides in the frame about midway between the frame ends. The tubular bar is threaded at one end to receive a ratchet-wheel held against longitudinal movement. A holder engages the frame ends and the bar to prevent the bar from turning and the ends of the frame from spreading. A drill turns in the tubular bar and can be moved longitudinally by the bar.

Railway-Appliances.

CAR-COUPLING.—JOHN B. EAVES, Forest City, N. C. The invention is a coupling in which the coupling-device itself is locked by means of a block or jaw pivoted within a chamber or recess in the coupling-head or draw-bar and adapted to swing vertically for engaging or releasing the coupling device. The strength and solidity of the draw-head enables it to withstand the shock of impact when the cars meet, so that supplemental buffers are unnecessary.

TRACK-SANDING DEVICE.—WILLIAM H. PRENDERGAST, Southern Express Building, Savannah, Ga. This apparatus is designed to feed sand to the rails under a locomotive in order to prevent the slipping of the wheels. The device can be readily transformed from a pneumatically-operated sander to a straightway device should the pneumatic apparatus sustain any injury. The air ducts and sand-cup can be easily kept free.

AUTOMATIC COUPLING.—THOMAS H. PATCHING, Strathfield, New South Wales. The invention consists of a ratchet-bar hinged to a draw-bar of ordinary construction, so constructed as to be received by a mating-section. The mating-section consists of two metal bars of peculiar construction, similarly hinged to a draw-bar of ordinary construction and having an eccentric pawl between them, which is operated by means of a lever. Whatever may be the draft-strain, the pawl can always be withdrawn from the ratchet, to disconnect the cars.

Miscellaneous Inventions

PERPETUAL CALENDAR.—JOHN M. BIGGS, 502 Fourth Street, Louisville, Ky. The calendar is of the perpetual-date class, and is provided with specific improvements in the manner of constructing and assembling the parts, so that the calendar can be cheaply made and securely held together. The material used is either sheet metal or cardboard. The calendar is a most attractive advertising-novelty, sufficient space being provided for advertising matter. The inventor manufactures his calendar in all sizes and shapes.

STRAIT-JACKET.—JAMES M. HOOPER, 128 N. Eutaw Street, Baltimore, Md. The invention provides a bed-sheet of extra-strong material, with appliances attached to give it the function of a strait-jacket, and attaching devices for securing the sheet to a bedstead, cot, surgical table, or other support. The strait-jacket is designed to hold a patient securely, to insure immunity from self-injury without in the least interfering with personal comfort. The strait-jacket can be adjusted to any cot or surgical table, and can be sterilized, washed and laundered.

VEHICLE-SHAFT SUPPORT.—EDWIN JARRELL, Riverdale, Kans. The shafts can be held in a vertical position, so as to be out of the way when bringing the horse into position for harnessing. The main object is to provide a support capable of being finely adjusted, so as to fit shafts of different shapes or shafts in which the cross-bar is at different distances from the thill-couplings or vehicle springs. The support utilizes the vehicle-springs; and a threaded shank for the supporting-arm is employed, so that the arm can be adjusted to a nicety to adapt itself to shafts of different forms and sizes.

PROCESS OF PREPARING SARDINES.—JULIUS WOLFF, 47 Hudson Street, New York city. One of the chief difficulties encountered in packing American sardines is the removal of the water from the fish, so that the oil is not rendered turbid and unpalatable. The inventor has devised a new process for preserving the sardines. The process consists in depositing them in receptacles, which are placed in an oven having a temperature of about 300° F., for about one-half an hour. The receptacles are then removed and immersed in oil at a temperature of about 235° F., and retained therein until the water remaining in the fish after baking, is removed.

CONCENTRATOR.—CLEOFAS GALVAN, Zacatecas, Mex. The concentrator is composed of two parts—a stationary separator, in which the material is subjected to the action of a blast, and a vibrating, concentrator-table. The air-blast throws the lightest particles of ore far enough to clear the concentrator-table, and the blast, instead of being an unbroken stream or current, consists of a series of jets, which act much more thoroughly to grade and separate the material. The portion of the material which falls upon the table is subjected to a separating action by the vibratory motion, the lighter particles being thrown off, while the concentrates are collected.

THILL-COUPLING.—JOHN FREDENBURGH, Athens, Penn. The coupling is designed detachably to connect the thills with the axle-clips of a vehicle. The device is constructed so that the thills may be raised or lowered to extreme positions, and so that while the vehicle is in use there will be no lost motion or rattling in the connection between the thills and the vehicle.

DOOR-CASING FASTENING.—JENS HENRICK ISAEN, Chicago, Ill. Eyes are attached to the inner sides of the casing-strips near their rear edges. Through the eyes, wires are looped and passed through openings formed in the casing-stud, the wires having their ends twisted together at the inner side of the stud. With these fastening means a door-casing can be completely finished and polished in a factory and then taken to a building to be put in place; for there is no danger of marring the wood or of breaking the plaster. The fastening devices, moreover, are wholly hidden from view.

COMPOSITION OF MATTER FOR FURNACE-LININGS AND OTHER PURPOSES.—RUDOLF KECK, Denver, Colo. In the production of lining bricks, burnt magnesian minerals are used which are mixed with a small percentage of binder such as tar, clay, or ferruginous loam, etc., and burned at a very high heat. It is, however, impossible to produce a thorough mixture, for which reason the bricks, if not immediately used, disintegrate. To overcome the difficulty, the inventor employs a flux or binder which can be used in large proportions without disintegration. For this purpose he finds the shale constantly occurring in the Jura-Trias along the eastern foot-hills of the Rocky Mountains admirably adapted.

WHIFFLETREE ATTACHMENT.—REINHOLD KLATT, Strong City, Kans. The invention provides means for preventing the reins from falling beneath the singletrees, the contrivance being particularly adapted for use in connection with pairs or teams of horses. The action of the singletrees can be controlled relatively to the guard-bar for the purpose mentioned. The singletree is held in its proper position and is prevented from tipping up or down, should the bolts between the singletree and the doubletree loosen. The cutting of the doubletrees by the singletree ends and tugs is also prevented. The device likewise serves as a stay-trap, taking the place of the usual leather strap over the center of the inside half of a singletree.

CURTAIN-FIXTURE.—JACOB KOLB, Lancaster, N. Y. Upon this fixture curtains may be adjustably hung in such a manner that they will be removed from the window sufficiently to permit inside blinds to be freely operated and to allow free access to the window. Curtains may be carried to one side of the window, leaving the full inner surface entirely uncovered. The supporting-sections of the curtains can be quickly taken down for adjustment, the curtains draped thereon, and the fixtures as readily restored to place at the window.

FIRE-ESCAPE.—AUGUST KURRE and WILLIAM H. GIESELER, Brooklyn, New York city. The fire escape can set up adjacent to a window or can be permanently attached to the casing of the window. It is so constructed that, after a person has descended from the building, the supporting tape employed for descending automatically wound up. An automatically-operated brake is provided for the tape.

TUBE EXPANDING, BEADING, AND CUTTING TOOL.—HENRY G. LUKKEN and JOHN C. HOISVEN, Grafton, N. D. The invention provides a gage for the tool, which gage comprises two members. The one member is turnable, is adapted to abut at one end against the flue-sheet, and is formed with teeth at the other end. The second member is secured to the tool-body and is formed at its inner end with teeth in mesh with the teeth of the first member. The two members are secured together after adjustment. By this means the tool can be brought into proper position.

VEHICLE-BRAKE.—RICHARD C. G. NEUMANN and GEORGE L. HARTMANN, Seattle, Wash. The brake is of that type which, in application, comes in contact with the ground and raises the rear wheels. The mechanism comprises besides the ground-shoe, a rock-shaft mounted in the vehicle, a hanger constructed in hinged sections, one of which is connected with the brake-shoe, and a connection between the rock-shaft and the hanger, so that when the shaft is rocked the sections of the hanger will be moved to bend or straighten the hanger.

FORMALDEHYDE-LAMP.—SIDNEY RAUSCHENBERG, Mount Vernon, N. Y. Formaldehyde is usually produced by passing air and methyl-alcohol vapor over glowing coke, platina, or copper. The process is not well under control; and hence there is danger of explosion of the alcohol-vapor. The inventor instead, uses an apparatus on the principle of a lamp, comprising a fount for methyl-alcohol, an asbestos converter prepared with platina and metallic oxids, a wick for carrying the methyl-alcohol to the converter, and a chimney.

AQUATIC CAROUSEL.—SAMUEL REDFERN, Negaunee, Mich. On a float a deck is built surmounted by a roof. An anchor-chain has a swivel connection with the bottom of the float. Sail-carrying frames have trunnions mounted in standards on the roof of the deck. Stops limit the movement of the frames in one direction. Ordinarily the sails will be sufficient to propel the float; but should greater speed be desired, or should there be no wind, an engine will be employed.

WATER-PURIFIER.—CHARLES A. SCADDING, Buffalo, N. Y. The object of the invention is to provide a new purifier, designed for use in boiling water in kettles and arranged to collect and store the impurities. The contrivance comprises a floatable vessel on the top of which a fluted collector is mounted, having its lower ends terminating above the top so as to form channels for the impurities to pass over the top into the vessel.

LABEL-CUTTER AND COVER-LIFTER.—WILLIS S. SMITH and DAVID W. LANAGAN, Chicago, Ill. Labels are often so placed upon boxes as to extend upon both the body portion and cover; and a knife is required to cut the label before the cover can be removed. To overcome the objection, a label-cutter is attached to the can or box, by means of which the label can be quickly cut at the junction of the body of the can and the cover-flange, the device also forming a finger-piece for removing the cover.

SASH-LOCK.—CONRAD F. STEIN and GEORGE BICKELHAUPT, 243 and 245 W. 47th Street, Manhattan, New York city. The device is arranged to lock the upper and lower sashes together and to lock the lower sash to the window-casing to prevent the opening of the window from the outside by forcing the screws used for securing the lock to the lower sash. The sash-lock comprises two bolts movable at an angle to each other, both being shifted by an operating-lever to an outward, locking position. A locking device holds the bolts in locking position; and another lever is employed to release the locking device whenever desired.

AMUSEMENT DEVICE.—GEORGE C. TILYOU, Coney Island, Brooklyn, New York city. The invention provides a device for application to a floor. The apparatus consists of a movable platform adapted to be depressed by the weight of a person. Cams are mounted beneath the platform and are driven continuously, so that when the platform engages the cams, a vibratory movement will be given to the platform. Simultaneously a great noise will be produced.

COMBINED CARD-CASE AND GAME-COUNTER.—WILLIAM TREWARTHA, Angel's Camp, Cal. Travelers often play cards to pass the time; and it would, therefore, be very desirable to be able to provide for cards a game-counter and cribbage-board which might be used temporarily and which would be inexpensive. Such an arrangement has been devised by the patentee of the present invention.

Designs.

WINDOW-SHADE RUNNER.—ZACHARY T. HEAL, Brooklyn, New York city. Two designs granted to the inventor provide new forms of runners for adjustable shade rollers, which are of such construction that they cannot change their position relatively to the guides.

TILE.—WILLIAM C. MORRISON, Smethport, Penn. The tile is provided with grooves which receive the cement. Thus the tile is firmly locked in place, the grooves being essentially locking devices.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE ELECTRIC AUTOMOBILE: ITS CONSTRUCTION, CARE AND OPERATION. By C. E. Woods, E.E., M.E. Chicago and New York: Herbert S. Stone & Company. 1900. 16mo. Pp. 177. Price $1.25.

At last we are beginning to have really valuable books upon the automobile. Most of the literature at present deals with obsolete types and other matter made up from patents. Now, however, it seems we are to have real live books, and we trust that the present will be the precursor of many. It is handsomely printed and illustrated and the subject is dealt with by an expert. There is an excellent skeleton for the organization of an automobile club in the book.

THE UNKNOWN. By Camille Flammarion. New York: Harper Brothers, 1900. 12mo. Pp. 485. Price $2

The publication of "L'Inconnu" made a veritable sensation in France, and it can hardly fail to arouse the greatest interest in this country. It is an eminent scientist's study of the phenomena of the so-called spirit world. In touching upon the various psychical manifestations, M. Flammarion cites many absolutely authenticated instances, and chapters of his book are as wiredly fascinating as the most fantastic of Poe's tales. It is always interesting to have a scientific man write a work of fiction in which more or less science is cleverly incorporated.

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References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(7886) H. C. K. asks: 1. I would like to know how high the vertical wire of the wireless telegraphy has to be to send a message one mile and how much higher every extra mile? A. For 1 mile, 90 feet; for 4 miles, 40 feet; for 16 miles, 80 feet. These numbers are from Fahres' "History of Wireless Telegraphy," price $2 by mail. This book gives a complete outline of the subject up to date of publication. 2. Is it necessary to have an induction coil for a telephone if you have a metallic circuit instead of a ground circuit? A. An induction coil is necessary when any form of transmitter is employed. It is not connected with the use of a metallic circuit. The metallic circuit prevents the induction of neighboring circuits from affecting transmission of speech. 3. How does an induction coil change the electricity so that it is felt very much although one cannot receive a shock from the batteries? A. By raising the voltage of the current so that it becomes able to force its way through the body.

(7887) J. L. S. asks the difference between the currents generated by a Torpler-Holtz and a Raney-Wimshurst-Holtz static machine. A. All static machines generate electricity of very high voltage and very small current strength. Thousands of volts are required to produce a spark of an inch in length, the number varying with the form and size of the terminals between which the spark passes. We are not aware that any essential difference exists between the currents produced by the machines named.

(7888) J. E. T. asks: 1. What is the best source of current for "electro plating?" A. A dynamo is now used for plating where ever there is work enough to make it economical. For a small plant or for small pieces, the Gravity battery may more economically be used. 2. Would the storage cell, described in SCIENTIFIC AMERICAN, of April 28, 1900, on page 261, be suitable for the art? A. Any storage battery may be used for plating if you have the means of recharging it. 3. Advise me, what would be the best book on Electro-Metallurgy? A. That depends upon how much you wish to pay for the book. We name Watts Electro-Deposition, price $3.50; Watts Electro-Metallurgy, price $1.00.

(7889) C. L. asks: How can I kill "poison ivy" mercury. The roots are in a rough, laid-up retaining wall alongside of my home, and impossible to dig out. Is there any cheap chemical that will kill it off? A. The only sure way to kill this pest is to dig it out and either burn it or dry it till it is dead. There are people whom it does not poison who can do such work. In your case you can try kerosene oil, or hydrochloric acid. Either of these will kill where it touches the plant. No complete ridding of the country of this vile weed can be had except all the people combine to fight it and enforce the laws respecting such plants.

(7890) P. J. M. asks: Will you kindly inform me how I can best secure a knowledge of the X-ray apparatus, its operation and its uses? A. The best method of learning the mode of working X-ray apparatus is to take lessons from some person of experience. There is danger of accident without such teaching. However we recommend the following books:—Morton's X-rays, price 75 cents; Meadowcroft's A B C of X-rays, price 75 cents; Thompson's Light Visible and Invisible, price $1.50; Walsh's Medical Use of X-rays, price $2.25; Bottone's Radiography, price $1.00.

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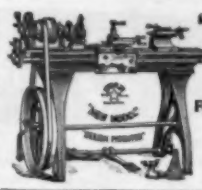

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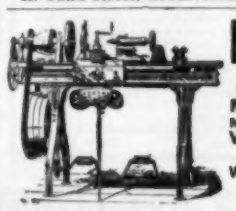

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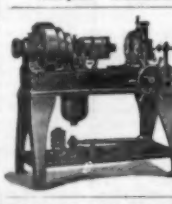

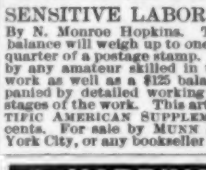

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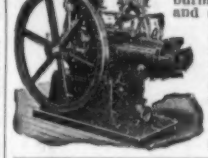

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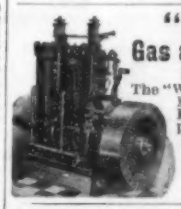

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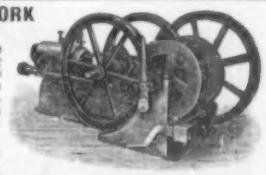

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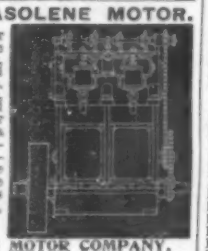

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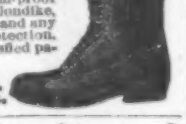

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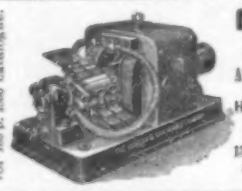

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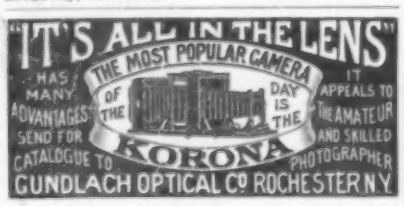
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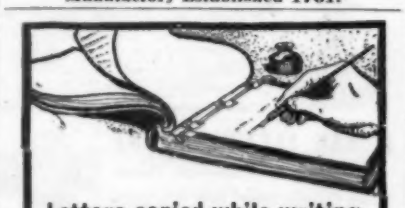

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COMMISSION
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NOTICE TO CONTRACTORS.

APRIL 19, 1900.

Bids will be received by the Commissioners of the New East River Bridge, at their office, at No. 256 Broadway, in the Borough of Manhattan, in the City of New York, at two o'clock in the afternoon of the 31st DAY OF MAY, 1900, endorsed "BID FOR CONSTRUCTION OF THE STEEL AND MASONRY APPROACH ON THE BROOKLYN SIDE OF THE NEW EAST RIVER BRIDGE," for furnishing the materials for and constructing the steel and masonry approach on the Brooklyn side of the New East River Bridge, in accordance with the proposed form of contract and the drawings and specifications therefor. All bids shall be enclosed in sealed envelopes, addressed to Lewis Nixon, President of the Board of Commissioners of the New East River Bridge, and presented to him on that day and at that hour at said office, and such bids will be opened in public meeting by the said Commissioners on that day at two o'clock in the afternoon.

Copies of the specifications and the general drawings for the work, with the proposed forms for the bid, bond and contract, may be seen, and further information will be given at the office of the Chief Engineer, No. 84 Broadway, Borough of Brooklyn, City of New York, on and after the 28th day of April, 1900.

The Commissioners require that all bidders shall carefully examine the specifications, drawings and proposed form of contract, in order that no question as to their meaning may arise hereafter. It must be distinctly understood that no changes in the quality of the materials or of the workmanship will be allowed, and that the specifications will be adhered to strictly.

The contract is to be completely performed within twelve months after the execution of the contract.

Bids will be made upon a form provided therefor, and only those bids will be considered which are complete, in proper form, comply with the requirements herein stated and are offered by parties of known reputation, experience and responsibility.

Each bidder will be required to deposit, with his bid, in the office of the Commissioners, a certified check for $6,000, payable to the order of Julian D. Fairchild, as Treasurer of the New East River Bridge Commissioners, as security for the execution by him of the contract and the giving of the required bond, if his bid is accepted, within two weeks after notice of the acceptance of his bid.

The Contractor will be required to give a bond in the penal sum of $200,000, in the form annexed to the proposed form of contract, with two approved surety companies doing business in the City of New York, conditioned for the prompt and faithful performance of the contract and its covenants and the work thereunder.

As by far the greater part of this work can be executed only by bridge establishments of the first class, bids will be received only from such parties as have the requisite plant and facilities, which have been in successful operation on work of similar character for at least one year. The bidders must be, in the opinion of the Commissioners, fully qualified both by experience and in appliances, to execute work of this character and importance according to the highest standard of such work at the present time.

The Commissioners reserve the right to reject any and all of the bids offered, and to accept any bid offered.

LEWIS NIXON, *President.*

JAMES D. BELL, *Secretary.*

COMMISSION
NEW EAST RIVER BRIDGE,
City of New York.

NOTICE TO CONTRACTORS.

APRIL 19, 1900.

Bids will be received by the Commissioners of the New East River Bridge, at their office, at No. 256 Broadway, in the Borough of Manhattan, in the City of New York, at two o'clock in the afternoon of the 31st DAY OF MAY, 1900, endorsed "BID FOR CONSTRUCTION OF THE STEEL AND MASONRY APPROACH ON THE MANHATTAN SIDE OF THE NEW EAST RIVER BRIDGE," for furnishing the materials for and constructing the steel and masonry approach on the Manhattan side of the New East River Bridge, in accordance with the proposed form of contract and the drawings and specifications therefor. All bids shall be enclosed in sealed envelopes, addressed to Lewis Nixon, President of the Board of Commissioners of the New East River Bridge, and presented to him on that day and at that hour at said office, and such bids will be opened in public meeting by the said Commissioners on that day at two o'clock in the afternoon.

Copies of the specifications and the general drawings for the work, with the proposed forms for the bid, bond and contract, may be seen, and further information will be given at the office of the Chief Engineer, No. 84 Broadway, Borough of Brooklyn, City of New York, on and after the 28th day of April, 1900.

The Commissioners require that all bidders shall carefully examine the specifications, drawings and proposed form of contract, in order that no question as to their meaning may arise hereafter. It must be distinctly understood that no changes in the quality of the materials or of the workmanship will be allowed, and that the specifications will be adhered to strictly.

The contract is to be completely performed within fifteen months after the execution of the contract.

Bids will be made upon a form provided therefor, and only those bids will be considered which are complete, in proper form, comply with the requirements herein stated and are offered by parties of known reputation, experience and responsibility.

Each bidder will be required to deposit, with his bid, in the office of the Commissioners, a certified check for $12,000 payable to the order of Julian D. Fairchild, as Treasurer of the New East River Bridge Commissioners, as security for the execution by him of the contract and the giving of the required bond, if his bid is accepted, within two weeks after notice of the acceptance of his bid.

The Contractor will be required to give a bond in the penal sum of $400,000, in the form annexed to the proposed form of contract, with two approved surety companies doing business in the City of New York, conditioned for the prompt and faithful performance of the contract and its covenants and the work thereunder.

As by far the greater part of this work can be executed only by bridge establishments of the first class, bids will be received only from such parties as have the requisite plant and facilities, which have been in successful operation on work of similar character for at least one year. The bidders must be, in the opinion of the Commissioners, fully qualified both by experience and in appliances, to execute work of this character and importance according to the highest standard of such work at the present time.

The Commissioners reserve the right to reject any and all of the bids offered, and to accept any bid offered.

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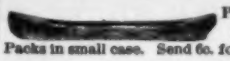

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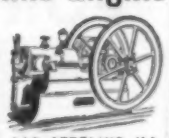

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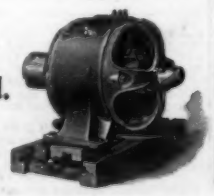

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